THE

AGRICULTURAL BULLETIN

OF THE

FEDERATED MALAY STATES.

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EDITORIAL NOTES.

STAFF APPOINTMENTS.

Mr. G. E. Mann, M.C., B.A., reported his arrival on the 10th October and assumed duties as Assistant Agricultural Inspector.

Capt. S. D. Timson, M.C., M.S.E.A.C., reported his arrival on the 1st November and assumed duties as Assistant Agricultural Inspector.

Mr. T. D. Marsh reported his arrival on the 10th November and assumed duties as Assistant Agriculturist.

Mr. A. Thomson, B.SC., reported his arrival on the 20th December and assumed duties as Assistant Mycologist.

Mr. E. A. Curtler, B.A., Camb. Dip. Agr. reported his arrival on the 21st December and assumed duties as Assistant Agriculturist.

TITI SERONG EXPERIMENTAL STATION.

At the Titi Serong Experimental Station (Krian) one hundred and twenty pure strains of padi, resulting from five years of selection, by the elimination of the poorest out of 1,300 strains, have been planted in quadruplicate plots for a further comparison of their yielding capacities. The mean yielding capacity of all these strains is over 20 per cent. higher than that of unselected races. In addition to the above, 230 pure strains, forming a representative collection of the better varieties of Malayan Padi and including some twenty imported varieties, have been planted out. This collection of types is maintained from year to year for use as foundation stocks for future cross-breeding, to test the length of time required to acclimatise imported varieties, to maintain small stocks of pure seed of varieties suitable for all types of soil, for the isolation of heavy-yielding strains of various varieties, local and imported, and for the selection of strains suitable for different purposes. The plantings included several large multiplication plots, in which strains of anticipated high-yielding capacity have been planted so as to increase the stock of seed of these strains for distribution, should they fulfil expectations in regard to yield.

VEGETABLE AND ESSENTIAL OILS.

As a result of enquiries made at the recent International Rubber and Tropical Products Exhibition, London, samples of vegetable oils and fats and essential oils have been prepared at the Department and forwarded for exhibition purposes to the Malay States Information Agency, 88, Cannon Street, London, E. C. 4, and to the Imperial Institute, South Kensington, London, S.W.

The following is a list of the samples already sent:

Malay States Information Agency.	*Imperial Institute.*
Palm oil	Palm oil
Palm Kernel oil	Palm Kernel oil
Castor oil	Castor oil
Rubber Seed oil	Citronella oil
Gingelly or Sesamum oil	
Candle Nut oil	
Borneo tallow (Tengkawang fat)	
Illipe fat	
Citronella oil	

In this way it is hoped to bring to the notice of those at home who may be interested in these products, the possibilities of this country in respect of the production of these oils.

It is intended also that these samples shall form a nucleus of a complete set of all economically important oils which can be produced here.

COTTON.

The Spinners' (England) report on the samples of cotton grown from seed introduced from the West Indies is very satisfactory. The quality of the locally grown cotton did not show any depreciation compared with that grown in the West Indies.

The crop suffers severely from the ravages of insect pests, which, together with uncertain rainfall, would appear to be the controlling factors in the successful cultivation of cotton in Malaya.

DRUGS.

A small block of land has recently been taken up with a view to the establishment of a collection of native medicinal plants. The land is being prepared and it is hoped that material for planting will soon be available.

PESTS AND DISEASES.

An apparently new Branch Canker of *Hevea Brasiliensis* is being kept under observation; several fungi have been isolated and inoculations will have to be carried out to decide which is the causal fungus.

A fungus not previously reported on *Hevea Brasiliensis* has been noted on badly grown rubber. It is a species of *Helminthosporium* which is the cause of the common spotting on leaves of young plants of *Hevea Brasiliensis*. This new fungus will grow on healthy *Hevea* seedlings but causes little damage.

Bowstring Hemp.

A sample of locally grown bowstring hemp, prepared at the Department of Agriculture, was forwarded to London for examination and the following report was received :

"A hard clean fibre, strength good, length fair, colour dull white, preparation good, texture fine, value £40 per ton (7-10-21)."

It was pointed out that small quantities would be much more difficult to sell than larger quantities as manufacturers would not care to touch it unless they could get supplies on a fairly large scale, say, 1,000 tons.

Sericulture.

The question of the breeding of silk worms and the establishment of sericulture as a "cottage" industy in Malaya has been under consideration recently. The Government Entomologist is of opinion that it is essential that a trained Entomologist should devote considerable time and attention to this problem, before it can be stated whether the industry is likely to be successful.

An article in this bulletin on "Sericulture as a Cottage Industry in Siam" is of considerable interest in this connection.

Malaya-Borneo Exhibition.

In order to encourage trade and to demonstrate the various raw products and industries of British Malaya and the adjacent islands and territories under British protection, His Excellency the Governor and High Commissioner, Federated Malay States, has decided that an exhibition to be called the Malaya-Borneo Exhibition shall be held in Singapore on the occasion of the visit of His Royal Highness the Prince of Wales, K.G.

The Exhibition will consist of the following sections :

Agriculture, Arts and Crafts, Commerce, Forestry and Minerals.

The following have been requested by His Excellency to form a Committee to organize the Section of Agriculture.

Captain B. J. Eaton, Messrs. I. H. Burkill, F. de la Mare Norris, D. H. Grist and J. N. Milsum.

The Committee has decided to compile and publish a handbook of Malayan Agriculture in connection with the Exhibition.

AGRICULTURAL BULLETIN.

This issue completes Volume IX of the Agricultural Bulletin, Federated Malay States for 1921.

It is proposed to change the title of "Agricultural Bulletin of the Federated Malay States" to that of "The Malayan Agricultural Journal", commencing with the first issue of Volume X, January, 1922. The Journal will be the Official Organ of the Department of Agriculture, Federated Malay States and Straits Settlements, from that date, and will be procurable by payment in advance of a subscription of $5 per annum (single monthly copies 50 cents). Those who wish to subscribe or renew their subscription for 1922 are requested to fill in the enclosed form, and to forward it with their subscription to The Editor, The Malayan Agricultural Journal, Department of Agriculture, Kuala Lumpur, Federated Malay States.

The title "Bulletin" will be retained for the "Special Bulletins" issued by this Department.

It is proposed during 1922 to revert to monthly publication but the first few issues will be delayed.

THE CULTIVATION OF TENGGALA PADI
(Concluded).

By D. H. Grist and Syed Abdul Rahman.

MATURATION.

THE influence of maturation on yield is very considerable. The short duration varieties of padi, be they wet or dry padi, give a smaller yield of grain, tiller less freely, and are less vigorous in most respects than those which require a longer period to mature. But the selection of padi with regard to maturation must take into account the local conditions of climate, and conform to the local custom. It is worse than useless planting an eight months' padi when all the surrounding cultivators are using a six months' variety, for the longer maturing variety will attract to itself all the pests of the neighbourhood.

In the tenggala districts of Pahang, the maturation season of the padi is ruled by the local conditions. The crop must be harvested before the monsoon, and the ploughing of the land cannot be commenced before the conclusion of the monsoon season. Short duration padi is therefore the rule. The average length of time taken by the padi from planting to maturity is from $4\frac{1}{2}$ to $6\frac{1}{2}$ months. This is short compared to the main crops of other districts. While considering the question of the poorness of the crops obtained, it must be remembered that it is extremely unlikely that the returns from tenggala land will ever surpass the wet padi crops. The Malays call short duration padi, "padi ringgan" (light padi), and the long duration padi, "padi berat" (heavy padi), and although they allude merely to the maturation period of the padi, there can be little doubt that the terms are based on the fact, well known to them, that maturation period and yield of crop are related.

TABLE 41.

Botanical Features of Tenggala Padi Grown at Pekan, 1917.

Variety.	Origin.	Nature.	Leaf surface.		Tip.	Sheath.	Ligule colour.	Ligule claw.	Band.	Remarks.
			Upper	Lower						
Sungkai	Pekan	Erect	very catchy	smooth	brown	green striated	straw	green pubescent	white	
Salak Tegap	,,	,,	catchy	,,	...	green	green	...	green	Leaf small, and of light colour
Sungom	,,	,,	Pub.	Pub.	...	green, edge sl. purple	straw	...	white	
Lebat Petai	,,	...	,,	,,	purple	purple inside	white	white	,,	A very wide leaf
Ambun	,,	...	,,	,,	,,	green	straw	pub. yel.	green	A very narrow leaf
Nias 1	Kolopong	Erect	catchy	sl. catchy	brown	,,	,,	...	straw	
,, 2	,,	,,	,,	rough	...	,,	white	...	white	
Lembut Ekor ...	Kerbau Pekan	...	sl. catchy	smooth	brown	pur. stri.	,,	white	,,	Leaf wide, dark green Stem purple
Lebat Ungoo ...	Pekan	Erect	Pub.	,,	...	...	,,	,,	...	
Jintan Puteh ...	,,	...	,,	,,	...	in purp. out green	sl. purp.	yel. pub.	yel.	Stem green
Jambak Bawang ...	,,	...	v. pub.	,,	...	green	...	large white	...	A very broad leaf
Jintan Kuning ...	,,	...	Pub.	,,	sl. purp.	,,	...	...	...	Leaf narrow
Lenggok	,,	...	,,	,,	...	...	...	...	...	Broad leaf
Lebat Chantek ...	,,	...	,,	sl. pub.	...	out green	...	...	...	
Bendang Sri ...	,,	...	v. pub.	,,	...	in v. purp. purple striated	...	...	...	Internode, both outside and in, very purple. Node green
Sunting Muar ...	,,	...	Pub.	smooth	...	green	...	...	green	
Lebat Chekor ...	,,	...	,,	,,	...	,,	large, green	...	,,	Internode purple, node green

V.=very. pub.=pubescent. out=outside. in=inside. sl.=slightly. yel.=yellow.

TABLE 42.

Observations on Inflorescence made in 1917. Pekan Padi Experiments.

Variety.	Panicle.	Empty Glumes.	Full Glumes.	Apiculus.	Awn.	Stigma.	Remarks.
Nias 1	Erect	$\frac{1}{6}$th white	green	green	absent	...	
„ 2	„	white	very green	„	„	?	
Lembut Ekor Kerbau ...	„	slight purple	light green	bright purple	1″ bright purple	white	Some without awns
Lebat Ungoo	„	white	light green	green	absent	„	
Jintan Puteh	...	small white	green	black	„	black	
Jambak Bawang	...	„	light green	green	„	white	
Jintan Kuning	..	$\frac{1}{6}$th white	light brown	„	„	„	
Lenggok	...	white	green	„	„	„	
Lebat Chantek	...	green becoming purple	„	purple	„	„	Stem purple
Bendang Sri	...	purple	Young green. Purple col. spreads down	„	„	„	„ „
Sunting Muar	...	white	green	white	occasional white $\frac{1}{2}$″	„	A needlelike grain
Lebat Chekor	...	purple	light green	purple	absent	„	

Note.—Fractions under "Empty Glumes" indicate length of empty glume to full glume. Fractions under "Awn" indicate length of awn in inches.

At the time that these records were made, many varieties were not in flower, which accounts for their incompletion.

Abbreviations above: col. = colour.

Notes on the Tenggala Padi Varieties.

Most of the varieties of padi tenggala are known to have been introduced to that system from the "hill padi" (or dry padi system), or from the swamp system. In fact, of the varieties here described, only in five cases are the writers uncertain of the original system under which the variety was cultivated. Tenggala padi varieties are therefore an adaption of those grown under other systems. Most of the padi here treated have been introduced into the tenggala system (experimentally) by the writers, and at least two have been "rediscovered" by them after the varieties had experienced years of obscurity. Such being the case, there is no reason to doubt that almost any padi can be acclimatized to suit new conditions. This period of acclimatization may be lengthy, and the padi may give little crop for some years. The period depends on the extent of the differences between the original condition under which the padi grew and the new conditions under which it is cultivated. The acceptance of this principle is of importance, as it opens up a wide field for selection amongst the padi of other systems. It is observed that the transferrance of a variety from one set of conditions to another generally spells the complete failure of the crop. For instance, the cultivation of wet padi from Siam, on dry land at Gemas, resulted in the production of less seed than was originally planted. Such seed as was obtained would be of great value if it possessed qualities which it was desirable to introduce into the stock of dry-land rices. The chances are that the second and subsequent generations would accustom themselves to the new conditions, the weak stock would be eliminated, and the new stock raised would possess many of the qualities of the original seed, adapted to the new conditions. These are matters of success to the experimenter, but the man who proposes to grow the crop from the commercial point of view would be well warned against the promiscuous selection of stock from one part of the country to be cultivated elsewhere, for he is looking for a return which will be sufficiently large to make the crop profitable, whereas the experimenter is considering only the ultimate benefit that he can confer on the industry, and is prepared to sacrifice the intermediate crops in order to gain the desired result.

In the following notes, the translation is given, in most cases, of the Malay names for padi. It will be seen that the name bestowed upon a padi by Malays is either descriptive, or denotes the place of origin.

Lembut Ekor Kerbau. (Ref. No. 1).—"The soft grained padi "buffalo tail".

Maturation period, six months, ten days. A variety grown very generally throughout the tenggala area, but in small quantities only. The Malay objects to the variety on account of its awns, the presence of which make the padi more difficult to clean. Lembut Ekor Kerbau, as its name indicates, is one of the soft grained varieties. Its cultivation is not recommended for very dry situations.

The padi has a light-straw coloured full glume, with a purple straight apiculus. The empty glumes are of a light purple colour.

The grain is needlelike and opaque. It breaks little in milling. For this class of padi, the yields are good.

Bendang Serai. (Ref. No. 2.) "Dragon Grass".—Bendang signifies the wet system of padi cultivation. This padi was therefore originally a wet padi.

Bendang Serai is one of the old Pahang padi. The bendang system is not now practised in the Pekan district. This variety, accepted as a padi tenggala, is cultivated mainly in the mukims of Ganchong and Temai.

The glumes are of a light yellow colour, as is the apiculus. The empty glumes are white. There are no awns.

The grain is moderately long, and cylindrical; rather dirty white in colour. The cuticle and endosperm are white. The variety is rather impure, several strains being obvious.

Jambak Bawang. (Ref. No. 3.) "Bunch of Onions", or in colloquial English, "Like onions on a rope".—As a tenggala padi, this variety has been cultivated along the Pahang River for many years, and can be found in any mukim. It is cultivated either as a wet, dry or tenggala padi. It is said to be especially suitable for cultivation on newly opened hill-padi land. The Malays in Negri Sembilan recommend it for planting on newly opened "sawah" (wet) padi land, which they say will not bear the long duration padi in the first few years.

The glumes are light yellow, and well filled. Apiculus, also light yellow, no awns. The grain is of good length, cylindrical, cuticle white, endosperm vitreous.

Lenggok. (Ref. No. 4.) "Waving".—This is an old Pahang variety, found in most mukims, but not especially popular. It is essentially a tenggala padi, probably originally a hill padi. The glumes are yellowish, the form of the seed being slightly curved. Apiculus yellowish, empty glumes, whitish. The rice is of medium size, of rather dirty appearance, brittle, vitreous throughout, cuticle, white.

Lebat Ungu. (Ref. No. 5.)—"The heavy padi with the deep purple colour" (referring in particular to the colour of the stem). This is an old Pahang variety. Mainly a tenggala padi, but can also be grown as a wet padi. Matures in six and a half months.

Glumes, darkish purple coloured: apiculus, purple; empty glumes, purple.

The grain is rather yellowish in appearance, some seeds have a red cuticle, i.e., impure stock, vitreous throughout. The grain is of good shape.

Lebat Chekor. (Ref. No. 6.)—"Chekor" means a low scrub. "A heavy yielding short padi."

The variety matures in just over six months. Originally a "padi bendang". The Malays say that it was first introduced into Pahang from Kelantan about twenty years ago. It can be cultivated as a hill padi, tenggala or wet padi. It resists extremes of climate (temperature and water conditions) is of vigourous growth, and tillers well. Racimes are borne at the top of the plant, and another set of racimes on a shorter stalk, i.e., the lower and shorter stalks are shaded by the rest of the plant, but yield seed. When planted in wet conditions the plant is tall, but on dry situations it is considerably shorter. When dead ripe, the padi must be harvested without delay, as the seed soon falls. Birds very much favour this variety. This is a favourite variety amongst the Malays, and it would appear, with good reason. Reference to table 39 shows that this padi ranks first amongst those tested with regard to the number of seeds per racime, is heavy, and contains but a small proportion of empty seed. It husks well giving 67 per cent. of unbroken grain. In planting this variety, less seed is required than is the case with other padi. (Five gantangs suffice instead of six.)

The glumes are of a light brown colour, with an apiculus of the same shade, and without awns. The grain is of medium size, well-shaped, even in character, and of very good appearance; somewhat brittle; vitreous with a white cuticle.

This is one of the most promising of the Pahang padi tenggala varieties.

Sunting Muar. (Ref. No. 7.)—The usual meaning of "sunting" is to wear a flower in the hair, or behind the ear. In this case it means that the padi being excellent, a small quantity is planted by the Malays of Muar. The meaning of "sunting" in this sense is shown by the following sentence: "Tanam bunga yang merah, di-sunting-kan bersama[2]-nya bunga yang puteh."

Padi Sunting Muar was originally a wet padi, but now, in Pahang, cultivated mainly as a padi tenggala. It is very mixed in character, and inclines towards being a "lembut". Grown in small quantities in mukims—Temai, Ganchong, and Tanjong Medang. The variety takes six months to mature.

Pale yellow glumes, apiculus of the same colour, slightly bent, empty glumes white. There are awned and awnless types.

The grain is very mixed, some having a red, and some a white cuticle. Some grains are distinctly more opaque than are others. Grain cylindrical, small and needlelike.

Lebat Chantek. (Ref. No. 8.)—"A beautiful, heavy yielding padi."

Maturation period, six months. A padi tenggala: If planted too late in the season, so that the grain is unripe when the monsoon season commences, it ripens with some difficulty. This does not apply to most varieties of padi tenggala. The variety is popular amongst the Malays who say that it is a good yielder; but their objection is to the necessity of early planting.

The glumes are whitish-brown in colour; apiculus, purple. The grain is medium in size, and of good shape. Cuticle white, with a fair appearance. Vitreous throughout.

Jintan Kuning. (Ref. No. 9.)—"The yellow padi of a caraway seed shape."

Matures in six and a half months. A "bendang" padi, now used mainly as a padi "tenggala". It grows as a "swamp" padi, and appears to be more satisfactory as such than as a "tenggala" variety.

The glumes are yellowish-brown in colour; apiculus of same colour and slightly bent. Empty glumes, yellowish. No awns. The grain is of good shape and appearance. Brittle; cuticle white; endosperm vitreous.

Jintan Putch. (Ref. No. 10.)—"The white padi of a caraway seed shape". Imported by the Malays from Kelantan, where it was grown as a padi "bendang". Has been grown as a padi tenggala for about six years. Matures in six and a half months. It is also cultivated in Pahang as a "paya" padi. Its cultivation as a "tenggala" padi restricted to the mukims of Pulau Tawar and Pulau Tambun.

Glumes, light yellow colour; apiculus, straight, and slightly purple. No awn. The grain is thin, but of excellent appearance. Entirely vitreous; cuticle white.

Nias. (Ref. Nos. 11 and 12.)—Nias is the name of the place from whence the padi was obtained. Introduced to the Pekan district in 1917, for experimental purposes. It produces very few tillers, and a correspondingly larger amount of seed (ten gantangs) has to be sown. The crops are not heavy. The padi ripens in five and a half months from the time of the sowing of the seed.

No. 11. Glumes, whitish-straw colour, with a bent apiculus of the same colour. No awns. The empty glumes are white in colour. Grain is of good shape, and a "clean" white colour, but rather broken. Vitreous throughout.

No. 12. Light yellow glumes; bent apiculus of the same colour. No awns; empty glumes white. Grain, fairly plump, medium size, an excellent white colour; vitreous, cuticle white.

Galak Tegap. Literally, "a firm post", meaning a stiff-strawed padi. (Ref. No. 13.)—Maturation period five and a half months.

Very little grown as a tenggala padi, it being really a hill padi from Luit and the other up-river mukims.

Glumes, a whitish-straw colour, apiculus bent, and of the same colour. The grain is fairly large, rather broken and of white colour. Vitreous throughout.

Sungkai. (Ref. No. 14.)—Sungkai is the name of a tree. The naming of the padi may mean that it came from Sungkai, or more probably to the fact that the colour of the bark of the tree of that name is similar to the colour of the stem of the padi.

Padi Sungkai matures in five months. It is really a hill padi, but not extensively grown. The rice has a sweet smell, which makes it somewhat popular with the Malays. The yields are not good, the plant producing but few tillers.

The shape of the padi is long and curved, bearing a few rudimentary awns. Apiculus yellow; empty glumes, white.

The grain is rather long, well-filled and of a good white colour, Cuticle white, endosperm vitreous. The rice, judged from the point of view of appearance, is one of the best found in this locality.

Senggom. (Ref. No. 16.)—Meaning unknown.

Really a hill padi, but introduced to the "tenggala" system by the writers. Matures in five months. It has a pleasant aroma, and is liked by the Malays. The plant produces but few tillers.

The shape of the seed is very long, cylindrical, sickle shaped. Glumes, pale yellow colour; awns, very short and white.

The rice is a mixture of red and white grained strains. Grains are long and cylindrical, some slightly curved as in padi Kuku Balam. Endosperm, vitreous.

Embun. (Ref. No. 15.)—"Dew." Probably originating from the fact that the padi will grow well in dry weather, when it must rely on the dew to supply its moisture. Padi Embun matures in rather over five months. It is a hill padi introduced to the "tenggala" system by the writers. The crops, as might be expected, are light. Being a hardy padi, it is useful for cultivation in situations where the land is subject to extremes of conditions. It is largely used as a hill padi in Pahang. The tillers are few. Glumes are whitish, empty glumes, brown. Apiculus, brown, straight. No awns.

Lembut Petai. (Ref. No. 17.)—"A soft grained padi shaped like the 'petai' pod."

Originally a hill padi, Lembut Petai has been tried by the writers under "tenggala" conditions. The yields, however, have been poor. This variety matures in five months. The seed is blunt looking, with very broad, white glumes.

Apiculus, coloured slightly purple. Empty glumes whitish; no awns. The grain is opaque, waxy, with a white cuticle. A few grains are found less opaque. Grain of medium length, and cylindrical, but of a somewhat dirty colour.

Muntit. (Ref. No. 18.)—"Muntit," the Pahang pronunciation of the Malay "montok" or "muntok" meaning squat; short and thick. "A short and thick padi."

A padi tenggala that was planted as such many years ago, but appears to have been lost. In 1918 the writers isolated the variety from a crop of Padi Lebat Chantek. The maturation period is six months. The yields are very good, the plants tiller freely, and the variety is suitable for general cultivation on "tenggala" land. Now that the variety has again been brought to light, the Malays are anxious to cultivate it.

Glumes, pale straw colour, apiculus of the same colour, and straight. No awns. Empty glumes white. The grain is short and rounded, vitreous throughout, and with a white cuticle.

Sri Pahang. (Ref. No. 19.)—"The beautiful Pahang padi." Matures in five months. The seed was obtained from the mukim of Pulau Manis, where it is cultivated as a dry-land padi. The variety, although it does not tiller freely, seems to adapt itself easily to "tenggala" conditions.

A whitish-straw coloured glume, empty glumes of the same colour, as is the apiculus, which is bent. No awn. The rice is of good appearance, grain long and cylindrical, and little broken. Cuticle, white, endosperm, vitreous.

Pulut Dukong. (Ref. No. 20.)—"Dukong" means to carry on the back, alluding to the fact that the grains are placed on the racime in paris, one above the other. "Pulut"—a "glutinous rice."

Pulut Dukong is a little known pulut, originally grown as padi "tugal". The writers have drawn this padi from obscurity, and there is now some local demand for the seed. It is a five months padi.

The seed is borne on the spikelets in pairs, and in some cases, in threes. The glumes are whitish-blue in colour, and strongly ridged along the entire length. Apiculus, purple, bent. No awns. This variety bears all the peculiar features of a "pulut". The endosperm is white and quite opaque, waxy in appearance. The cuticle is dark purple, almost black in colour. The grain is of good shape, regular, and little broken.

Ribu. (Ref. No. 21.)—Malay for "thousand"; meaning a heavy yielding variety.

Seed obtained from the mukim of Bera, where the Malays obtained the variety from the Sakai. Not known to the Malays of Pekan, until the writers introduced it, as a "tenggala" padi. It is a five months padi.

Glumes, light yellow colour; apiculus, light yellow, straight. No awns. Empty glumes, white. The rice is a short, plump grain of medium appearance. Cuticle, white; endosperm white, partly vitreous, brittle.

Jarum. (Ref. No. 22.)—"Needle," alluding to the shape of the grain.

Obtained under the same conditions as Ribu. A five months padi.

Glumes, a dirty white colour; apiculus, purple, bent and not bearing awns. Empty glumes white in colour. The grain is rather long, with a red cuticle. The shape is rather similar to No. 29, but more plump, and also truer to type. The endosperm is white and vitreous.

Alor Nibong. (Ref. No. 23.)—The meaning of this name is somewhat vague. "Alor" means a channel, or groove; "nibong" is the name of a plant. The allusion is probably to the colouring of the grooves of the glumes.

Alor Nibong matures in five months. The seed was obtained as in No. 21.

The glumes are a bright golden yellow, the apiculus purple. The colour is regular throughout the glumes. The grain is regular, short, plump, giving it a round appearance. Very little broken. Cuticle white, endosperm vitreous.

Mutan. (Ref. No. 24.)—Meaning of word not known. Obtained as No. 21. Matures in about five months.

The glumes are whitish, as is the apiculus. No awns; empty glumes white. Shape of seed curved.

The seed is long and thin, little broken, but the grain rather yellow. Cuticle white, endosperm vitreous.

Lumut. (Ref. No. 25.)—"Moss." Connection not obvious.

Lumut was obtained as No. 21. Matures in rather less than five months. The grain is sickle shaped, long and cylindrical. Top of full glumes purple and apiculus purple coloured. Rudimentary, purple awns. Empty glumes purple. Cuticle white; endosperm vitreous.

Choring. (Ref. No. 26.)—Means,—"Streaked with purple" i.e., referring to the appearance of the unripe glumes. Choring was obtained under similar conditions to No. 21. It matures in rather under five months. The glumes are brown, with a deeper colour at the apiculus. The grain is short, and has a red cuticle. The endosperm is white and vitreous, with an opaque spot at the centre.

Kuku Balam. (Ref. No. 27.)—"Dove's claws"; referring to the shape of the grain.

A five months padi obtained at the same time as No. 21. Glumes are a very light coloured yellow; apiculus, yellow bearing a few rudimentary purple coloured awns. The empty glumes are white.

The grain is long and thin, somewhat curved in shape. Cuticle, in some cases red, but the majority white. Endosperm white and vitreous throughout.

Anak Lebah. (Ref. No. 28.)—"The grub of a bee." The allusion is to the resemblance of the padi, which has very white glumes, and a very dark purple apiculus, to the grub stage of the bee, which has a very white body, and a black head. It is a five months padi.

The seed was obtained from Bera, as No. 21. It is grown by the Malays at Chenor as a "tenggala" padi, and as dry padi by Malays in other mukims.

Glumes; white with purple apiculus which is straight.

A few bear very short awns, purple in colour. Empty glumes, slightly purple.

The grain is short and plump, white in colour and little broken. Vitreous endosperm.

Turun Daun. (Ref. No. 28.)—"Falling leaves," alluding to the character of this padi, for it is noticed that when the padi nears ripeness, the leaves droop very much.

Turun Daun matures in rather under five months. The seed was obtained from Bera as No. 21. It was originally a dry padi. The glumes are white, with a somewhat "blue" shade. Apiculus purple and bent. Empty glumes, copper brown; no awns.

The grain is fairly long and is thin, with a red cuticle which is easily removed in polishing. The padi is not true to type, some grains being found with a white cuticle. The endosperm is white and vitreous.

Batang Mas. (Ref. No. 30.)—"The golden coloured stem." The reference is true to the colour of the stem of this padi.

The variety was obtained at the same time as No. 21. It is a five months padi.

The glumes are of a reddish-yellow colour. Apiculus, very dark purple, bent, awnless. Empty glumes, purple.

The grain is dirty looking, irregular; of medium length; rather broken; cuticle white; endosperm, white and vitreous.

Bunga Memachang. (Ref. No. 31.)—"Flower of the 'machang' fruit," alluding to the similar colour of the flower of the machang to the glumes of the padi before ripeness.

Bunga Memachang matures in under five months. It was formerly used by the Malays as a padi tenggala, but has gone out of cultivation. In 1919 the writers isolated the variety from a crop of Padi Lebat Chantek. The tillering is good, and the yields excellent.

The glumes are of a streaky brown appearance, strongly ribbed down the entire length of the glumes. Apiculus, straight, white, bearing no awns. Empty glumes, white.

The grain, of medium size, is not very easily broken, has a rather yellow cuticle, vitreous endosperm.

Terong Chendana. (Ref. No. 34.)—"Terong," brinjal; "chendana," sandlewood. "The padi shaped like a brinjal, and with the aroma of sadlewood."

The writers obtained the seed from Padang Buloh, Pekan. It can be grown as a wet or dry padi. In the Pekan district of Pahang as mainly a "tabur" padi, or a "tenggala" padi. Popular amongst the Malays on account of its hardy nature and its aroma. It is especially suitable for late planting, as the plant does especially well if there is wet weather when the seed has "set". The yields are rather poor, and the seed is minute. It requires nearly six months to reach maturity.

The glumes are either light yellow, or purple tinted. They are thin and very close to the kernel. Apiculus, purple, no awns. Empty glumes, white.

Terong Chandana has a very small, purple coloured grain, which does not easily become broken in husking. It closely resembles the wet padi known as "Burong" and like the latter padi, Terong Chandana is mostly used for the feeding of birds.

Dry Padi Seed from the Planters' Stores and Agency, Klang.

This is similar seed to that supplied to planters on rubber estates in 1919. The padi is good, producing a large number of tillers, many of which however produce no racime. The growth is tall, but the plants do not stand dry weather at all well. This is a six months padi. The glumes are reddish-brown, bearing an apiculus varying in colour from reddish-brown to purple. There are a few bearing rudimentary awns which are white. The empty glumes are white.

The grain is of medium size, and of good appearance. Cuticle and endosperm, white, and the latter vitreous. The seed is very brittle.

The stock is promising but, judging by the large amount of straw produced, the writers are of opinion that the variety is suited to the wet conditions of cultivation rather than the dry.

Seed obtained from Sime Darby & Co.

The leaves of this variety are very broad, the plants are tall, and produce a fairly large number of tillers. The seed is very mixed. This is a variety that matures in under five months. The crops are poor.

Glumes, light straw coloured with awns varying in length from one inch to three inches, and in colour from white to dark-purple. White awned padi containing seed with a white cuticle, dark awned with a red cuticle.

The grains were of several types, both red and white cuticle types being seen. Grain broad, and of average length. Endosperm, vitreous. Seed very brittle.

This padi seems to the writers to have been a very unsatisfactory one for general distribution. Being of short maturation period, no large crops could have been expected, and the introduction of padi of mixed types such as this is to be discouraged.

Notes and Suggestions.

While the "tenggala" system of padi cultivation contains the elements of good husbandry, it is evident, judging by the very unsatisfactory returns obtained, that either the local conditions are unsuitable for the crop, or that the system fails through the fault of those responsible for its culture. The writers are not prepared to admit that the local causes are fully to blame for the present condition of affairs, but rather is it a fact that the natives

have failed to adapt the cultivation to the conditions as they find them. It is perhaps a pertinent question to enquire whether the crop realized is sufficient to compensate for the cultivation. If it is found that this is not the case, a ready explanation of the rather indifferent attitude of the natives towards this crop is at hand, and the solution of the difficulties recognizable.

It has been seen that, on the experimental plots, the average yield is well over one hundred gantangs, and that some varieties have given a yield of over three hundred gantangs per acre. If this is possible on the experimental plots, is it not also possible throughout the district? The reasons for the difference in yield have already been stated, and it remains now to show the cropping returns that should be obtained, and the other problems that effect the situation. First, the consideration of cost; secondly that of labour; and thirdly, the machinery necessary to carry into effect the recommendations made as a result of this investigation.

THE COST OF PRODUCTION OF ONE ACRE OF PADI TENGGALA BASED ON A PERIOD OF FOUR SUCCESSIVE YEARS OF CROPPING.

The following estimate of the cost of production is based on the prices of labour obtaining in April, 1920:

	$ c
Cleaning land of blukar and burning same $4	
Therefore annual cost	1 00
Stumping... ... ... $4	
Therefore annual cost	1 00
1st ploughing 6 days at 70 cts. per diem ...	4 20
2nd „ 5 „ „ ...	3 50
3rd „ 4 „ „ ...	2 80
Raking 2 days at 70 cts. per diem	1 40
Cost of seed 6 gantangs at 20 cts. per gantang ...	1 20
Cost of broadcasting seed	10
Covering the seed 4 days at 70 cts. per diem ...	2 80
Harvesting 12 men for one day at 50 cts. each ...	6 00
Cleaning padi crop of 150 gantangs; 3 days at 50 cts. per diem	1 50
Rent on land	60
Implements, say	4 00
Total cost per annum per acre	$30 10

RETURN.

Crop of (say) 150 gantangs at 20 cents per gantang	$30

Yield of Padi in the Pekan District.

A report on "The system of padi planting in the Pekan district," in 1900 by the (then) District Officer, Mr. T. C. Fleming, states that the approximate area of land planted with rice in that year (in the Pekan district) was as follows:

Swamp	1,715 acres.
Plough land	2,615 ,,
Ladang	890 ,,

The writer stated as his opinion that the above may be considered as the average area annually brought under cultivation. The areas are rather more than that planted at the present time. Mr. Fleming further estimated that the yields were at the following rate per acre: swamp 450 gantangs, and plough land about 200 gantangs. The figures for yield are decidedly higher than those obtained at the present time when swamp gives an average of under one hundred gantangs per acre, and tenggala possibly just over the hundred gantangs per acre. No accuracy, in the matter of figures for yields, can be obtained at present, but the above approximate figures demonstrate the fact that there must be a considerable improvement in the yields if the industry is to progress. The small crops obtained, materially affect the area planted. A yield of one hundred gantangs per acre gives a return of $33, so that there is a loss per acre of about $5.

Labour.

Labour constitutes another crucial point in the cultivation of padi. With the use of primative implements, labour must be cheap and plentiful. It is now neither the one thing nor the other. Nowhere along the Pahang River is there sufficient labour to plant up the present rice fields. Poor crops have caused the population to move away to other more favoured spots.

The use of buffaloes has been considered as essential for the cultivation of "tenggala" padi. It follows that any increase in the area cultivated must mean a proportional increase in the number of buffaloes in the district.

The following figures were supplied by the District Officer, Pekan, and refer to the natural increase of buffaloes in the year 1917. The figures are typical of the annual returns of the district:

Total buffaloes in 1916		4,917
,, ,, 1917		4,956
Total No. buffaloes born since last census (i.e., yearly)		904
No. young buffaloes died	815	
,, ,, killed for consumption	96	
No. young buffaloes otherwise died ...	67	
,, ,, sold out of district	299	
		777

By deduction, number of young buffaloes left in district 127

Thus, one-third of the young buffaloes died, while the increase of buffaloes in the district for the year was practically nil.

The cause of this high mortality amongst buffaloes is to be found in the ignorance of the Malays of the proper care of young animals, and to the poorness and insufficiency of their food during the monsoon season. In this season many of the grazing grounds for buffaloes are under water. No substitute foods are supplied to the animals. When the floods subside, the grass is covered with a coating of mud. Forced to eat this grass, the young animals frequently develop intestinal troubles, diarrhoea being very common. The necessity of instruction to the Malays in the feeding question is apparent. Instruction in feeding is useless unless accompanied by a ready supply of the necessary foods. Experimental work at Pekan has borne this in mind in the consideration of the introduction of crops for rotation with padi. Apart from such crops (as described under "catch-crops") there are other grass crops that could be grown in the district, and which make excellent food for cattle.

In 1917, three hundred head of cattle (young buffaloes) were sold out of the Pekan district. A large number finds a market in Negri Sembilan. This sale represents a promising industry, and deserves every encouragement.

The alternative to the use of buffaloes is motor-ploughs. Recently these have been tried on the Pulau Tawah padi tenggala areas, and at Pulau Tambun in the Pekan district, and further trials are under consideration. There would appear to be a future for this method of cultivation.

Conclusions.

The cultivation of padi tenggala in the Pekan district of Pahang has made no advance during the last twenty years. The area of land annually cultivated under the system is between one and two thousand acres, the importance of the question being not so much on the basis of present areas cultivated, as on the possibility, through improvements in conditions of planting, and varieties of padi, of increasing the total area cultivated.

The climate of the Pahang River includes a definite monsoon season, when the rainfall is very heavy. The padi season is between these rainy seasons. The writers do not advise moving the planting season until a closer study has been made of the effect of season on the crop.

Analyses of padi soils in the Pekan district are given, and it is shown that the soil is suitable for the crop. A greater detail of analyses is required, however, before conclusions can be drawn on the chemical and mechanical conditions most suitable for this class of padi.

"Tenggala" padi is grown on the same soil for several successive years, and, after the land becomes exhausted, it is abandoned for a number of years. With the object of devising a system of continual crop production on "tenggala" padi land, a large number of crops has been experimentally grown. The value of the continual cropping of the land, by means of a rotation of crops is stated to be:

(*a*) Restoring the fertility of the soil with regard to its nitrogen content;

(*b*) Increasing the total production of foodstuffs in the district;

(*c*) Providing increased production of cattle-foods;

(*d*) The interchange of crops on land makes full use of the various resources of the soil;

(*e*) The mechanical condition of the soil improves with cultivation.

Owing to the climatic condition, it was necessary to obtain varieties of plants which would be of short duration, or be sufficiently hardy to withstand flooding.

In view of the necessity of increasing the production of buffaloes in the district, and of preventing the enormous death-rate amongst young cattle, it was necessary to produce some crops that would be of use in the feeding of these animals. A large number of crops was tried, the table on page 22 showing the eight most successful of the crops grown.

It was found that the weeding of padi gave an increase in yield of 17 per cent., for one weeding, but that there was no material further increase as a result of subsequent weedings. The increased yield of 17 per cent. is insufficient to pay for the cost of this operation.

An experiment to contrast the effects of dibbling and broadcasting the padi seed when sowing, showed that the broadcasted seed gave an increase of crop amounting to 68 per cent. as compared with the dibbled seed. The difference may have been due to some extent to the fact that different quantities of seed were used in the two systems, and further experiments are necessary to prove this point.

An experiment is in progress to test the effect on yield of the continuous cropping of land with "tenggala" padi. The crops have not been large for the three years of testing and there does not appear to be an diminution of crop produced.

The necessity has been established for a rotation of crops for "tenggala" land. An experimental rotation has been in progress for three seasons, which has included two padi crops. The yields have been above the average for the district.

"Tenggala" padi is of three kinds: "pulut," soft glutinous rice; "lembut," soft grained padi; "Gansa"—the hard grained rice. In experiments on the varieties of "tenggala" padi, it was found that, as a rule, heavier crops were obtained from the old established tenggala varieties than from the varieties recently introduced to the system. A collection of the varieties of "tenggala" padi has been made, and in addition several varieties of "hill padi" introduced to the system. The varieties used for tenggala land are very mixed in character, and the writers have been able to isolate two varieties, which had degenerated into obscurity, and which were found to give very much larger yields than the average of the other varieties grown in the district. The detail of the crops obtained from each plot of padi in these tests for three years is given, followed by notes on the origin, and chief characteristics of each of the varieties. The botanical features are given of eighteen of the varieties.

The weight per gantang of padi varies very considerably with different varieties; and the amount of rice produced to weight of padi taken is also variable. Padi tenggala produces a heavy padi in a good season, and the quality of the padi, judged from the point of view of the liability to break in husking, compares very favourably with the wet padi. The effect of the maturation period on the extent of the crop is discussed. The shorter the maturation period is the smaller the crop produced. The average length of time from planting to maturity with "tenggala" padi lies between 4½ to 6½ months.

The yield of padi on the experimental plots at Pekan averaged three times as much as the average of the district. The writers are of opinion that the causes of this large difference are as follows:

(*a*) A 17 per cent. increase on account of weeding;

(*b*) The district figures include areas where the entire crop may have failed;

(*c*) Care taken on experimental plots to guard against the attacks of pests;

(*d*) Improved and careful cultivation, and systematic planting;

(*e*) Only improved and carefully selected seed used on the experimental area;

(*f*) The fact that the Malays employ too great a quantity of padi for seeding their fields. The plants are therefore weaker, and tiller less.

SERICULTURE AS A COTTAGE INDUSTRY IN SIAM.

By F. W. South.

DURING a recent visit to Bangkok, the writer took the opportunity, on the suggestion of the Government Entomologist, to make enquiries concerning silk culture in Siam. By the kindness of the Consul-General facilities were given for obtaining first hand information concerning the matter. In view of the similarity of characteristics of the Malay and Siamese peasants, the information obtained concerning the present poor condition of sericulture in Siam and the failure of the efforts made by the Siamese Government to improve the industry, may be of interest, when the possibilities of developing a silk industry in this country are considered.

Silk Weaving.

Silk weaving on hand looms is carried out to a considerable extent in Siam mainly in villiages in one district in the northern (Chieng Mai) district and on the Korat plateau on the east.

In the north the raw silk is brought by a laborious overland journey from Mandalay in Burma and is spun and woven into a fine quality silk cloth by the Siamese (Lao) women. It is then taken back by the men and sold in Moulmein. Practically none of the silk from the north was sold in Siam until, quite recently, a change in the fashion of ladies' garments, decreed by the King, has created a considerable demand in Bangkok for the northern manufacture.

This appears to be the more purposeful part of the industry.

On the Korat plateau there are fairly numerous hand looms, one village of some size has as many as 100 looms or more, but the work is carried out by the village girls entirely as an occupation for their spare time. The raw silk used is imported from that part of Cambodia which lies just across the mountains opposite Korat, where the people are of almost identically the same race as those on the Korat plateau, especially that part of it near the mountain range. The silk is brought round by sea to Bangkok and is sent from there to Korat. In the Korat looms it is woven into Siamese garments, which are valued for their fine quality and fetch a good price. On the average, working as she feels inclined, a girl produces about one garment in a month. This sells for 25 or 30 ticals, the materials costing about 15 ticals (10 ticals = 89 at the present rate of exchange). This price is considered satisfactory, as nothing is allowed for labour.

Silk Culture.

This is practically confined to the Korat plateau; the moth used is *Bombyx mori* and the food plant is always the mulberry. There are two definite varieties; the larvae of one form are practically white, while those of the other are strongly striped. These varieties were recognized by the Japanese. These authorities stated that the Siamese worm is the smallest in size and the smallest producer in the world, but at the same time is hardy and disease resisting.

All the work is done by the women, mostly in their spare time. The preparation of silk thread from the cocoons is done by the oldest and feeblest women of the village. No care is used in preparing it and the final product is of extremely poor quality and is never woven in the local looms. This poor quality silk is bought up by Chinese and Indians, eventually passes into the hands of certain Indians in Bangkok and is sold in India, apparently mainly for adulteration purposes, or for very poor quality goods. The local price for this silk is 5 to 8 ticals per kati. Sericulture is a very old established industry on the Korat plateau, but appears to have degenerated very seriously; though the closely allied people living across the mountain range in Cambodia still produce high quality raw silk. In this connection it was stated that when the padi crop failed in Korat, as it was liable to do, no silk was produced, the reason being that the women had no time for it, as they had to go out to search for roots and berries to feed their families. This is significant as showing the value set on the industry as a source of income.

The Government Attempt to Improve the Industry.

About nineteen years ago the Government took up the question of improving sericulture. Money was voted and a well-trained man was engaged from Japan. He had good scientific qualifications from a Japanese University with special experience in sericulture. He obtained a certain number of Japanese assistants and started a silk farm and school in Korat with the best Japanese methods and appliances. A number of girls from the villages were paid good wages by the Government to work and be instructed in the farm and school. The girls went there on account of the money, but regarded the work as very laborious and were glad when their training period was over and they could return to their homes. Once back in their villages they took no further interest in what they had learnt; but continued their old bad methods. The farm produced an improved strain of moths and distributed the eggs free to any Siamese who asked for them. Very few took any interest in the eggs and those who obtained them took no special care of them. The Government also distributed improved implements, as used by the Japanese, free of cost, but of these no use was ever made and they may still be found unused in the thatch of the houses. The Japanese found certain parasites of the silk worms, and warned the Siamese that these must be kept away from the caterpillars, but again their

teaching met with no results. After ten years, on the appointment of a New Minister of Lands and Agriculture, the whole question was reconsidered. It was found that the quality of the silk produced in the villages had if anything deteriorated, although the Japanese at the farm were producing silk of excellent quality by their sound methods, and that the quantity produced had remained stationery. In consequence the farm was closed. At the present time no trace of the work done by the Japanese remains. The girls trained by them, when asked why they do not use the methods taught them, or if they have forgotten them, say that they remember them well enough, but they require too much trouble. Apparently it is not the time required that they object to, but the care and attention needed, when they are actually engaged on the work.

Thus the attempt to impose improved methods from without met with no internal response among the people themselves, mainly on account of the national temperament, and consequently was a conspicuous failure.

CHEMICAL NOTES.

By B. J. Eaton.

Vulcanization Researches.

CERTAIN investigations on the effect of storage on raw rubber have been completed.

The results obtained confirm previous preliminary work carried out in this laboratory, showing that the rates of cure of all types of rubber change during storage. Generally, fast curing rubbers cure more slowly after storage, while slow curing rubbers cure more rapidly, so that the tendency is for the rates of cure to become more uniform as a result of storage of the raw rubber.

These results are probably brought about by the alteration or partial destruction of the special accelerating constituents present in the rapidly curing rubbers and the slow formation of other accelerating substances in the slow curing rubbers, although no definite proof of this is available.

The tensile strength of the stored rubbers, especially samples which have been stored in the form of crepe, deteriorates considerably as has been stated previously in connection with the preliminary investigations on this problem. This deterioration is considered to be a surface effect and if large quantities of rubber are stored in block form or in large masses, so that air is excluded, such deterioration will not take place or will only take place on the surface of the stored rubber. Rubber containing moisture such as "Slab" rubber and fine hard para will not deteriorate on storage. Slab rubber of originally high tensile strength, which has been stored in the form of crepe, appears to deteriorate to a greater extent than original crepe rubber of medium strength.

Slab Rubber.

A certain demand still exists for slab rubber and a consignment of one ton has recently been prepared on the Department's estate at Pondok Tanjong for shipment to America. Another estate still continues to ship this type of rubber to America.

Paper Manufacture.

Experiments on the manufacture of paper pulp are being continued and a number of raw products has been received from the Forestry Department for investigation. These include several varieties of bamboo and a number of local woods.

Mixed jungle woods which have been advocated as a source of paper making material have proved unsatisfactory, as was anticipated.

These wood pulps have been prepared by chemical methods and not by mechanical treatment. The bamboos have given satisfactory results.

Soils and Fertilisers.

The question of local supplies of fertilisers has received attention, but apart from the existence of several deposits of guano and the mineral phosphate from Perlis, the local sources of suitable fertilisers appear to be small.

Experiments are being conducted on the value of the mineral phosphate from Perlis, which is now being worked by a new company—British Malayan Phosphates, Limited.

Samples of this fertiliser appear to consist in some cases chiefly of the mineral Wavellite, a hydrated phosphate of aluminium.

The fertilising value of this substance will require to be tested by field and pot culture experiment. Samples of locally manufactured castor seed cake have been analysed and the cake recommended as a fertiliser.

Vegetable Oils and Fats.

In addition to those oils and fats which have been despatched to London (cf. Editorial Notes, page 238), a large number of samples, together with meals, is also being prepared for the Malaya-Borneo Exhibition.

Samples of gingelly oil grown by the department on Castleton Estate, Telok Anson, have been examined, as well as samples of Borneo tallow and Illipe fat.

Essential Oils.

Samples of the more common essential oils which can be produced in this country are being prepared for the Malaya-Borneo Exhibition.

Several experimental distillations of Citronella grass have been carried out for estates.

Peat.

Trials with local peat as a fuel for producers for gas engines have been carried out with satisfactory results.

It was found possible to utilize peat containing 40 per cent. of moisture.

The chief drawback is the limited scrubbing capacity of the plant now available, which causes the engine piston to become very dirty.

Researches on Alcohol Production.

The principal investigations have been in connection with the sap obtained by tapping the fruiting stalk of the nipah palm. Promising results have been obtained, but it is essential to continue these investigations probably for at least a year, before reliable estimates can be made. The utilization of the sap both as a source of sugar and alcohol is being considered.

A SIMPLE BEEHIVE INCINERATOR.

By F. W. South and G. H. Corbett.

Introduction: The Problem of Refuse Disposal.

It is well known that accumulations of decaying vegetable matter, such as the manure from cattle-stalls, heaps of village refuse, and of sawdust, serve as very suitable breeding grounds for the black coconut beetle, *Oryctes rhinoceros*, and that coconut trees in the neighbourhood of such accumulations are often severely damaged by these insects.

The destruction of such rubbish is often a matter of some difficulty. It is not always possible to bury it and it is usually so wet that it will not burn freely on an open bonfire. Burning such heaps as they lie is useless, because, at the best, only the less damp and surface layers are destroyed, while the half decayed material inside the heap, where it is most suitable to the beetle grubs, is left untouched by the fire. Beetle grubs have been found in large numbers in old manure heaps, the surfaces of which had been burnt previously to a depth of several inches.

Refuse heaps of the kind mentioned are usually to be found in, or on the outskirts of, villages and small towns in the Federated Malay States and in the Colony. In the Colony, especially, where suitable Crown land for the purpose is often not available, the disposal of village refuse frequently presents serious difficulties. Such refuse usually consists of shop sweepings containing old tins, straw bottle-wrappers, pieces of old boxes, paper and other substances and is increased in certain seasons by accumulations of fruit skins. Often such refuse is dumped by several adjoining house-holders on vacant building lots in the village, or on a piece of waste land behind the main street. There is usually a definite and approved dumping ground for rubbish, somewhere near a village and the Sanitary authorities do their best to confine all rubbish to such places, but their efforts have to be continually renewed in many instances and are often only partly effective. Even on the approved dumping ground the refuse is often left to rot, being neither buried nor burnt. Such rubbish-heaps must tend to breed flies and other insects as well as beetles and be insanitary from the medical as well as from the agricultural view point.

During recent work on the control of coconut beetles, which consists especially in destroying all suitable breeding grounds, the writers were impressed with the absolute necessity of providing some means for destroying adequately accumulations of rubbish, especially village refuse and manure from cattle-sheds. Conversations with officers returned from the war suggested the possibility of building some cheap form of beehive incinerator such as was

commonly used for destroying refuse behind the lines on various fronts. Cavalry units, when stationed in the same place for more than 24 hours, were required to erect such an incinerator to destroy the sweepings from the horse lines and the incinerator had to be made fly-proof. It was usual to make the incinerator of sods, of turf, of clay, of stones plastered with mud, or of tins filled with earth and covered with mud.

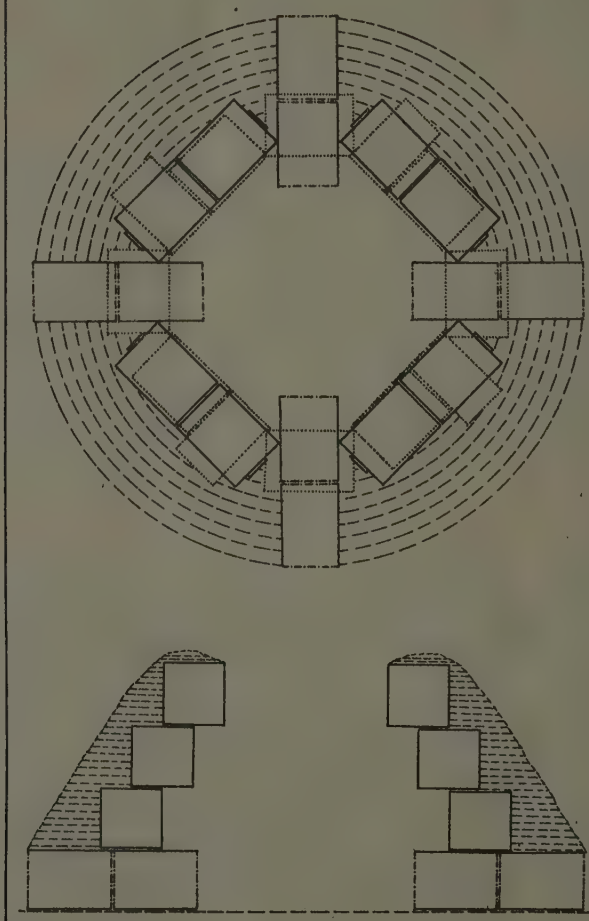
Preliminary Experiment.

The first experiment was started with a small incinerator built of kerosene tins filled with earth, over the outside of which wet earth was plastered. These kerosene tins, filled with earth, were considered to be the most convenient material, suitable stones or rocks being usually unobtainable in this country. A full description of the method of building the incinerator is given below. The first incinerator was built at the Experimental Station in Kuala Lumpur and was used to burn wet cattle manure from a heap adjoining a bullock-shed. A good fire was started at the bottom with dry grass, fern and sticks and the drier surface manure was then fed on to this fire. When this was burning well, thoroughly wet material was added gradually. The mass burnt slowly, but after 24 hours the success obtained was considered sufficient to justify a further experiment on the destruction of village refuse in a suitable locality.

The Principal Experiment.

Site.

At the entry to the village of Alor Gajah, in Malacca, on the road from Tampin, there was a dump of village refuse on a small piece of unused land at the side of the road. Beyond this piece of land was a padi sawah and the rubbish had been dumped partly on the flat above the sawah and partly on the slope of the bank running down to it. This rubbish dump contained the refuse accumulated from the village during a period of at least nine months, more probably about 18 months; the exact length of time could not be definitely ascertained. From this dump large numbers of grubs of the rhinoceros beetle had been obtained on several different occasions; for example, on one occasion 49 grubs were obtained from about one cubic metre of the rubbish. The condition of the neighbouring coconut trees testified very clearly to the damage being caused by the adult beetles bred in this rubbish-heap. The heap consisted of all kinds of waste material, such as bits of cloth, paper, straw bottle wrappers, old ataps, old boxes, decaying fruit skins and numerous coconut husks. In addition, there were large numbers of empty milk tins which must have served to breed mosquitoes. The top layer, about two inches deep, was fairly dry, but below, the mass was wet and half decayed, offering the most suitable conditions for black beetle grubs. It was decided, therefore, to erect the incinerator on this piece of unoccupied land at the road side, quite near the rubbish-heap, to determine if most of the rubbish could be satisfactorily burnt at a reasonable cost and in a reasonable time.



BEEHIVE INCINERATOR.

Method of Building the Incinerator.

Forty-four kerosene tins were purchased. The lids and bottoms were cut out of eight of these. One of the remainder was supplied with a wooden handle and was used for carrying water, while thirty-five were filled with earth. For the ground tier, eight of the filled tins were laid out in the form of a square, having two tins to each side. At each corner a space was left, into which was fitted one of the empty tins, from which the bottom and top had been removed. Each of these corner tins was laid with its long axis parallel with the diagonal of the square. The filled tins forming the sides were laid base to base, so as to make a fairly close joint in the middle of each side. The remaining four empty tins (with top and bottom removed) were laid one at each corner, each end to end with one of the original four. *See* plan fig. 1. The empty kerosene tins at the angles serve as air inlets. Two are required at each angle on account of the projection of the earth covering with which the tins were finally plastered.

When the tins had been laid in position, soil was filled into the angular spaces at the corners and banked up against the tins round the outside. It was found convenient to wet this soil thoroughly.

Before placing the second tier of tins in position, flat pieces of board were laid across the tops of the empty tins at the corners to assist in supporting the weight of the tins and soil above them in the second tier. These boards, taken from old boxes on the rubbish-heap, were of sufficient length to project at each end on to a filled tin, by which they were supported. Pieces of board were also laid at right angles to these, along the tops of the hollow tins, one end of each board being supported on the board lying below it. These boards were to assist the outer hollow tins to support the weight laid on them. A filled tin was then placed on each of these boards with its length across each corner and was allowed to project a little towards the centre of the incinerator. The sides were completed with two filled tins to each side, one placed with the length parallel to and one with the length at right angles to the side. These tins were also pushed somewhat inwards, so far as they could be without over balancing, in order to reduce by degrees the internal diameter of the incinerator. The plan of this tier is given in the plan fig. 1. It forms an irregular octagon. Soil was packed into angular spaces and gradually built up against the outside of the structure.

The third tier consisted of eight filled tins placed in the form of a regular octagon. The tins were laid across each angle of the tier below as far as possible and were again pushed somewhat inwards so that the circumference of the top was further reduced. Soil was packed in and built up as before.

The fourth and top tier consisted of seven filled tins placed in a heptagon across corners as far as possible and fitted as was found practicable. The circumference of the opening was again reduced. Soil was filled into the spaces and wet mud, brought up in baskets from the sawah below, was plastered on the outside. Two coolies carried the mud and one man filled the baskets.

The work was begun at 2 p.m. on 4th April. There were employed, the Sub-Inspector of Agriculture, Alor Gajah, his notice-server and four coolies. The writers supervised and assisted in placing the tins. The Sub-Inspector and notice-server also placed the tins and filled the spaces with earth, while the coolies filled the tins, dug earth and carried mud from the sawah. After three hours, i.e., at 5 p.m., work was discontinued, as all that remained to be done was to finish covering the outside with wet mud. The coolies and the two subordinate Agricultural officers commenced work at 6 a.m., the next morning, and completed it by 9 a.m., when the incinerator was ready for use. The construction was, therefore, completed in six hours. The cost is as follows:

Cost of Construction.

Materials.—	
44 kerosene tins at 26 cents	$11.44
Labour.—	
1 Sub-Inspector of Agriculture at $1 per day ...	1.00
1 Notice-server at 60 cents per day	.60
4 coolies at 60 cents per day	2.40
Total ...	$ 4.00
Total cost ...	$15.44

Work of the Incinerator.

A fire was first lighted in the incinerator by using dry paper, straw, bits of dry wood and old boxes from the drier parts of the dump. When the fire was well started the rubbish accumulated during the previous four days was placed on the fire and successfully burnt. This four days' accumulation was almost completely burnt in two hours. Subsequently rubbish from the old heap was added steadily, so as to keep the incinerator fairly full, but not to choke it; ordinary cooly baskets, such as are used for carrying soil, were used to feed the rubbish into the incinerator and one basket of drier material was used to two baskets of wetter rubbish. At intervals the ash from the bottom was raked out through the air holes with a stick. Nearly all the rubbish was found to have been thoroughly consumed to a fine ash and the paper had been burnt off the milk tins which had usually become unsoldered.

Feeding the fire and raking the ash were only necessary at intervals. Consequently the coolies were made to rake over the rubbish-heap and lay out the inner wet material in a thin layer about one inch deep near the incinerator. A trench was dug and all the tins removed from the dump were placed in it. The Sub-Inspector of Agriculture and the notice-server were present and were shown this procedure so that they could continue the work on the same lines.

The fire was banked up in the evening and left to burn all night. It was found to be still burning on the next morning. We examined the incinerator about 11 o'clock that day and were well satisfied with the results obtained. The rubbish had been almost entirely reduced to a fine ash. Three coolies worked on this day.

After the first two days' work it was decided to continue the work with only two coolies each day. The Sub-Inspector of Agriculture and the notice-server were instructed to supervise alternately. The Assistant Agricultural Inspector, Malacca, was instructed to exercise a general supervision and to pay the wages.

The following instructions were given to the Sub-Inspector:

1. The rubbish was to be laid out in a thin layer to dry, when there was no rain and the partly dried rubbish was to be fed into the fire.

2. Tins were to be removed and buried in a trench.

3. The ash was to be raked out at intervals and examined to see that all the refuse was properly consumed. Any large unburnt pieces were to be put back.

4. If cracks appeared in the earth covering of the incinerator, they were to be plastered with fresh mud from time to time. If necessary the outer covering could occasionally be moistened with water.

5. A record was to be kept showing the number of baskets of rubbish burnt each day, with a note on the weather conditions and on any repairs to the incinerator. This record was to be sent to the Assistant Agricultural Inspector each week.

6. All grubs of the black beetle, found during the burning of the rubbish dump, were to be killed.

Results Obtained.

The work under this new arrangement was commenced on 7th April and continued until 23rd April. No work was done on Sundays, so there were 15 working days. In that time 1,332 baskets of rubbish were burnt giving an average of nearly 89 baskets per day. The largest number burnt in a day was 120 baskets and the smallest number 50, owing to rain. On 8th April, five baskets of mud were put on the outside of the incinerator and on 13th April, seven baskets of mud were used. Rain did not put out the fire, but naturally reduced the rate of burning. The wetter and more decayed rubbish near the bottom of the heap was somewhat troublesome to burn.

The following remarks are taken from the report of the Assistant Agricultural Inspector, Malacca, on the work done by the incinerator.

"On the whole it must be said it worked with fair success, but some difficulty was experienced in burning the rubbish which had reached an advanced stage of decay.

"An improvement might be effected in the erection and the working of the incinerator, if some means could be devised of instituting a grating over the first row of tins—thereby creating a greater draught, quicker burning, freedom from selection of burning material and easier clearing out of ashes from below. The general results taken all over are satisfactory, the initial and working costs being insignificant compared to the results achieved."

Probably the improvement suggested could be obtained by laying iron bars with their ends flattened out across the first tier of tins. They would certainly assist considerably in supporting the rubbish burning in the incinerator and so improve the draught and simplify the removal of the ash.

COST OF THE WORK.

Construction of the incinerator		$15.44
Labour.—		
5th April.—Four coolies half day at 30 cents	$ 1.20	
6th April.—Three coolies one day at 60 cents	1.80	
7th to 23rd April.—Two coolies 15 days at 60 cents (excluding Sundays)	18.00	
Total ...	$21.00 ...	$21.00
Supervision.—		
Work of Sub-Inspector and notice-server for 17 days approx. ...	$15.00 ...	15.00
Grand total ...		$51.44

Therefore the rubbish dump, accumulated during at least nine months—more probably eighteen months—was destroyed in 17 days for a total cost not exceeding $52. This figure does not, however, include the cost of the European supervision necessary to start the experiment and supervise the work. As supervision of all kinds of experiments is the proper duty of Agricultural officers it is scarcely fair to charge their services to this account.

REMARKS.

The completely decayed material at the base of the rubbish dump formed a manure rich in humus. This could have been mixed with the ash from the incinerator and spread on the padi field below. The neighbouring Malays, who owned this sawah, were informed of this fact and told they could have the material

for the trouble of removing it. We are not aware that any of them availed themselves of the opportunity, possibly because the harvest had recently been reaped and no work was being done on the sawah.

It seems probable that, with more experience in the work and some improvements in the incinerator, the rate of burning rubbish of this description could be increased and thereby the cost be reduced.

General Considerations.

The work was undertaken for the purpose of determining whether an incinerator of the type described could successfully destroy this considerable rubbish dump for a reasonable cost and in a reasonable time. Once the experiment had been concluded, no attempt was made to continue the destruction of subsequent accumulations, as it was felt that such work was a function of the Sanitary authorities and not of the department. Rubbish-heaps only concern the Agricultural Department in so far as they serve to assist the spread of agricultural pests.

The incinerator was, however, left in position and has been used regularly by the Sanitary authorities for destroying the village refuse up to the time of writing. Information has been received that it destroys two hand-cart loads of rubbish daily and that only one cooly is employed both to collect and to burn this. As one cooly was previously employed to collect the rubbish on the dump, the burning must have involved but little extra cost. The incinerator is still in good order though it has been necessary to restore the mud covering occasionally. This further experience tends to support the suggestion that a grating within the incinerator would add considerably to its efficiency, as the rate of burning is at times rather too slow and some of the rubbish is not quite completely consumed. The results obtained from its daily use are, however, satisfactory and undoubtedly a great improvement has been effected on the old method of allowing the rubbish to accumulate.

Further experiments are desirable to ascertain the durability of incinerators built of various materials and of the improvement effected by inserting iron bars to support the burning rubbish. Tests are also required as to the possibility of burning absolutely fresh wet manure from cattle-sheds in an incinerator fitted with such bars. It is hoped that some of this work can be undertaken in the near future.

It is suggested that such incinerators, after further testing, might possibly be utilized in the majority of villages for disposing of refuse, and might also be erected near any considerable sized cattle-stall and at cattle quarantine stations to dispose of the manure. In the last case there is occasionally a large production of infected manure that cannot safely be used for agricultural purposes and has, therefore, to be disposed of by burning or by

burial. Its disposal has been known to present a difficult problem in one instance. If experiments show that sods of turf in some localities and clay in others can be used alone to build a reasonably permanent structure, the cost of each incinerator could be reduced to the small sum necessary for labour and for the iron bars, if required. Kerosene tins would only be necessary for the air vents.

We wish to acknowledge the friendly co-operation of the District Officer, Alor Gajah, throughout the experiment.

DESTRUCTION OF RATS.

By H. W. Jack.

THIS subject has been brought up so frequently that it is worth while recording my own experience in Krian and Kuala Kangsar, as well as the experiences of writers in England and Java.

Rats play an important role in the dissemination of disease germs, plague (carried to man by fleas which infest rats), trichinosis, and other parasites, and fevers, by mechanical damage to drains, etc., but in this country their chief crime is their great destruction of food and food crops.

They are the enemies of the henroost, the coconut, the padi field and all sorts of stores. The gradual waste and consequent financial loss caused by the depredations of these vermin is not easily detected but is continuous and soon amounts to a considerable sum.

In the Krian district of Perak, it has been estimated roughly that rats destroy at least six per cent. of the crop or approximately one million gantangs of padi, which would be sufficient to feed 10,000 Malays for one year. This computation does not include the damage done to padi stores in every cultivator's house, which must be considerable.

Thousands of rats can be found in every large rice store and even small stores harbour hosts of them. Recently, in a store belonging to the Department of Agriculture, containing only 55 bags of padi, six coolies in one hour caught and killed 78 large rats, and about forty escaped.

The damage done to young coconuts by rats in the Bagan Datoh district can be estimated in thousands of dollars. Two thousand acres in one locality have been known to be completely destroyed and, on all plantations, precautionary measures, which are fairly costly, have to be taken to combat this pest.

Although the problem of rat extermination is a difficult one, owing chiefly to the migratory habits of these rodents, it is necessary, both from an economical as well as from a sanitary and medical point of view, that stringent measures be taken to combat the nuisance. In Europe, rats have increased at an alarming rate during the last five years, owing to the war, lack of labour, accumulation of stores and neglect of ordinary precautionary measures.

At the London docks, rats do incalculable damage and in 1919 the port rat-catchers killed over a million. In rural districts, farmers suffer severely from the deprodations of these rodents as they consume and destroy root-crops, fruit, eggs, vegetables, etc., and it has been estimated that in 1908 they caused damage to

food-stuffs to the value of £15,000,000 in England alone, which is but a mere fraction of Europe, and the value of food has increased very considerably since then. There are two species of rats in Europe—the black and the brown, but the latter predominates in the proportion of 10 to 1 and is thus the chief source of destruction of food and spread of plague. The brown rat migrated westward from China, appearing in hordes in Europe in 1730 and is almost identical with the destructive rat common to Malaya, though several other species are said to abound also. Rats breed very prolifically and commence at an early age. They may have several litters a year, averaging six to nine young but the writer has seen litters of 17 in Krian and litters of 22 have been known. It is said that one pair of rats will give rise to a progeny of 880 in nine months and the average gestation period is only 21 days. Abundance of food leads to larger and more frequent litters and a lower mortality of young rats, for, when food is scarce, the parent rats eat their young and are not able to support large litters. They are fierce, voracious, cannibalistic, agile, cunning, good climbers and swimmers and can adapt themselves to almost any surroundings. The migratory habits of rats are well known. In large padi areas, for instance, when the fields are flooded and cleared for planting and food is scanty, they will tour in hordes and destroy every rice nursery in a block of land of some 100-200 acres in one night. The writer has seen hordes in Krian, which he estimated at anything between 150 and 400. These hordes are more common at a sowing time following a bad harvest than after a good harvest, and the rats eat up every grain of padi in every nursery they encounter.

Similarly in Europe many instances of hordes migrating in search of food or frightened by disease are well known. The rat menace to food, property, and health became so acute in the British Isles that in 1919 legal powers were given to the Ministry of Agriculture to enforce rat destruction in areas which proved to be particularly badly infested, and similar powers in force in this country might be more rigorously pursued, especially in rice growing districts. In a campaign against rats it is essential that energy and zeal should be displayed by all concerned in carrying out the necessary methods of destruction; half measures are practically useless.

Preventive Measures.

Preventive measures consist in the protection of all food supplies from rats, the careful removal and destruction of waste, the rat proofing of buildings, the protection of ventilators, drains, sewers, etc., by gratings, fumigation of ships and store-rooms from time to time, the filling up of rat burrows with sand or glass and tar or similar material.

Methods of destruction:

(1) Protection of natural enemies;

(2) Poison;

(3) Trapping and hunting.

(1) Large numbers of rats are killed daily by their enemies (herons, owls, snakes, ferrets, hawks, cats, dogs, mongoose, etc.), which should be protected. Snakes and the mongoose are probably the most important of our local fauna in this respect. In Krian rice fields, where they both abound, the writer has found three medium sized rats in one average sized (five feet) cobra and it was found that the season following one in which snakes were killed almost daily on the Rice Experiment Station area was characterized by unusually large numbers of rats, and consequent excessive damage to the padi crop. Fatal snake bites are so uncommon in this country that it is questionable whether snakes should be killed at sight as so frequently happens, for even when they bite, their poison, though causing intensive pain and temporary paralysis, is I believe, rarely known to cause death. To give another instance, as many as twenty freshly killed rats have been found in a single owl's nest, though these birds are persecuted because their presence is regarded as an ill-omen.

(2) The number of rat poisons in use now-a-days is legion, some are effective and some are not. The active poisoning agent is usually one of the following: Barium carbonate, phosphorous, arsenic, strychnine, squills and plaster of Paris. In using poison great caution must be observed so that only rates can have access to it. Domestic animals must be safeguarded and unused baits should be collected and destroyed, if placed where there is any chance of their being eaten by useful animals. Dead rats should be burned or buried. Frequent change of bait is essential, as rats are very cunning and if any of their number die from eating any particular kind of food, they quickly learn to avoid that food, unless it is artfully disguised. Also poison and bait must be handled as little as possible as the rats will easily smell anything which has been handled and become suspicous. A little aniseed or musk oil will prevent this contingency and simple dyes will serve to disguise baits.

(*a*) *Barium carbonate.*—This poison is tasteless and odourless, efficient and fairly safe. It can be used as a powder sprinkled on fish, bread and butter, etc., or mixed with rice in the proportion of 1 part of poison to 8 parts of rice, or made into dough with oat meal or rice flour, rolled out and cut into half inch cubes. In the dough form the proportion should be 4 parts of meal to 1 part of poison.

(*b*) *White Arsenic.*—This is commonly used by Malays in rice fields and kampongs and known as "warangan". A grasshopper or other insect is caught and killed and into a split in its back a pinch of powdered white arcenic is inserted and the bait is then placed in a conspicious position, often amongst padi husks. "Warangan" is also used mixed up with rice in the proportion of 1 part powdered poison to 12 parts of rice, or made into dough with flour in the same proportions, with a little sugar added and the mixture cut into half inch cubes.

(*c*) *Arsenite of Soda.*—This is also effective and is best mixed with oat or maize meal in the proportion of 12 parts of meal to 1 part of poison and made into a thick dough by the addition of the

white of egg or coconut oil and the mixture cut into small cubes. A good mixture is one kati of meal, one kati of brown sugar, and two teaspoons of arsenic well mixed up together and put in small heaps near the rat runs.

(*d*) *Strychnine*.—This is a very effective poison but too dangerous for general use, owing to its highly poisonous nature. Crystals may be inserted into grasshoppers, raw meat, or fish, or made up with powdered biscuit and sugar. A good preparation is half an ounce of strychnine dissolved in one pint of boiling water, to which is added one pint of molasses; the bait, padi or maize, being afterwards soaked in the diluted syrup.

(*e*) *Phosphorous* (*Yellow*).—Many of the patent rat poisons contain this chemical, which is a good poison, but its use is too dangerous, owing to its inflammable nature.

(*f*) *Carbon bisulphide*.—This liquid is deadly in its effects and is especially useful where rat holes are apparent, when a little cotton wool or kapok moistened with the liquid is placed in the burrow and all the rat holes are blocked up with thick mud. It should not be used near dwellings, on account of its highly poisonous fumes, and great care must be exercised to avoid bringing any flame near the liquid, which is highly inflammable.

(*g*) Sulphur dioxide, chlorine, carbon monoxide, and hydrocyanic acid are useful gases for fumigating rats in confined spaces, sheds, houses, rat holes, etc., but they are dangerous to use and are only efficient if all air inlets are thoroughly blocked. Ordinary white ant pumps are useful for injecting gases into rat runs.

(*h*) *Local poisonous plants*.—The chief poison plant used by Malays for destroying rats is a specie of Dianella which they call "sisiak". The rootstock of this plant is pulverized and boiled up with ten times its volume of rice and the bait is then placed about the rice fields in little heaps. There are also a few other plants but little is known yet as to their poisonous properties.

When poison has to be laid near poultry houses, the bait can be put into the node of a bamboo, wide enough to admit rats but not fowls or domestic animals and beyond the range of their beaks or paws respectively. Another method is to use two boxes, one considerably larger than the other and each having two or more holes in the sides just large enough to admit rats. The poisoned bait should be placed on the bottom and near the middle of the small box and the larger box should then be inverted over it.

(3) Traps.

(*a*) *Guillotine traps*.—Numerous patent traps are available, but many of them are ineffective, owing to the sagacity of the rats. The best kind is the "guillotine" type, but it must be used intelligently, frequently moved and differently baited. There are several forms of this type of trap but the simpler the form the better, and an all-metal one is preferable, as it is less likely to absorb and retain odours. Good baits in this country are pieces of dried fish, sections of maize cobs, raw meat, cheese rind, buttered toast, fresh vegetables, rice, oat meal, etc. The "schyler" trap was found very effective in Krian and Bagan Datoh.

(*b*) *Cage traps.*—Cage traps are useful, but expensive and troublesome, where rats are numerous. They should be baited and left open for several nights until the rats are accustomed to enter them for food. They should then be closed and freshly baited, when a large catch may be expected. It sometimes pays to conceal a cage trap by covering it with thrash or putting it into a wooden box having a hole at one end, against which the opening of the trap is fitted.

(*c*) *Deadfall traps.*—The simplest trap and that which has proved far the most effective in the rice fields is a "deadfall"—a heavy plank or sod of grass resting on a light bamboo frame, supported by a figure-4 trigger, which is well known to the Malays, and temptingly baited.

(*d*) *Barrel trap.*—This consists of an ordinary barrel with a sheet of stiff brown paper tied across the top. Rats are fed with baits placed on the brown paper top for several nights and then a cross is cut in the top so that the rats fall into the barrel. It is advisable to prop a few bits of wood against the barrel so that rats can easily reach the top. The barrel should contain about eight inches of water with a surface film of kerosine. There are numerous other traps, but the above are easily the best.

(*e*) A scheme which seems worthy of experiment, is to trap rats alive in cages and to kill only the females and liberate the males. This scheme should, if carried on with sufficient intensity, result in a large excess of males, which would so harrass the females and each other that little effective pairing would take place and the mortality of litters would greatly increase. This might be tried experimentally in the first place with caged rats.

Hunting.

Organized rat clubs, which have done much good in England, America and Java, might be instituted in badly infested areas where there is a fair population. In America these hunts take the form of contests between two sides or villages, the beaten party having to entertain the winners. In England rat and sparrow clubs are numerous, prizes being given for catches during definite periods, in order to sustain interest and effect. Thus one club in Kent destroyed 28,000 sparrows and 16,000 rats, by the trivial expenditure of £18 ($155) in prizes. Such clubs would do much good in large padi areas in this country, if energetically organized, for it is estimated roughly that local sparrows (burong pipit) take five per cent. of every rice crop, in addition to the amount destroyed by rats.

The following are approximate prices for some of the various poisons mentioned in the text and for rat-proof wire netting and expanded metal obtainable locally through Messrs. McAlister and Co., Ltd.

Barium carbonate	...	10 cts. per lb.	White arsenic	...	20 cts. per lb.
Arsenite of soda	...	10 „	Sulphur...	...	10 „
Carbon bisulphide	...	30 „	best purchased in drums of 4 gallons		

3/8 inch expanded metal $1.10 per sq. yard in pieces of 6 × 2 ft.
„ „ lathing 1.00 „ „ „
¼ inch mesh wire netting .40 cents per sq. yard or $20 per roll of 50 sq. yards.

Conclusion.

In these trying times, when food is scarce and expensive the rat problem is one of serious importance and ought to gain the attention of every agriculturist and every business man in the country: if any organized destruction is to be carried out, it must be done thoroughly over as wide an area as possible, must be repeated periodically, and the methods varied or combined to get the best results.

Summary of Recommendations.

(1) Protection of the natural enemies of rats.

(2) Increased cleanliness about markets, stores, houses, etc.

(3) Construction of rat-proof stores, houses, drains, granaries, etc.

(4) Removal of garbage, of straw, husks, etc., from padi fields.

(5) Systematic destruction of rats by poisoning and trapping.

(6) Organization of rat clubs for continuous and systematic warfare against rats.

ESTATE TREATMENT OF MOULDY ROT.

THE following is an abstract of a letter, received from an estate manager on the suggestion of the Mycologist, in order to obtain a reliable estimate of costs of treatment of Mouldy Rot with "Agrisol." Previous experiments proved this material to be a reliable fungicide against "Mouldy Rot" but costs were not considered carefully. The information contained in the letter proves that under estate conditions the Agrisol treatment of Mouldy Rot is comparatively cheap, and for this reason can be recommended for use.

"In June, 1920, the fungus was noticed in a Chinese owned estate, adjacent to the boundary of this estate, and in July a number of badly affected trees were found in field 5.

On making a close examination of the whole area in tapping, it was discovered that this fungus was noticeable wherever tapping operations were being undertaken, and it therefore became necessary to deal with an area of 1,460 acres. Over the whole of this area, the system of tapping at that time, was a single cut, tapped alternate daily. The same system was continued until May, 1921, when an alternate daily V was substituted over an area of 218 acres. The area tapped on the alternate daily V was gradually increased until by the end of August an area of 980 acres was being tapped on this system. From September onwards, there has not been any further change.

As soon as the presence of the fungus was noticed, daily painting of the tapping cut was started, and the surfaces of trees suffering from the disease were painted; various disinfectants, in varying strengths, were tried, but from October (1920) onwards daily painting with a ten per cent. solution of "Brunolinum Plantarium" was adopted and, in addition, at the end of every fortnight, the excised surface was coated with a mixture, containing 50 per cent. tar and 50 per cent. Brunolinum.

It was decided in May to experiment with "Agrisol." Four tapping tasks were taken, in each of which there are 400 trees. A 20 per cent. solution of "Agrisol" was used, and the following figures will demonstrate the results recorded:

No. of trees diseased prior to painting ...	813
12 days after first painting with 20 per cent. solution of Agrisol	523
12 days after second painting with 20 per cent. solution of Agrisol	102
12 days after third painting with 20 per cent. solution of Agrisol	77

The original and last censuses were taken by an assistant, the two intermediate ones being undertaken by the same assistant, with the aid of an experienced kangani. The results were sufficiently encouraging to warrant a much more extensive experiment with this material, and as the results continued to be satisfactory, nothing but this treatment has been used since July.

After treating "Mouldy Rot" with Agrisol for a period of five months, it is possible to express the opinion that, if the trees are painted every ten days with a 20 per cent. solution, the disease can be kept under thorough control, but at the same time it cannot be claimed that this treatment will eradicate it. It is probable that the number of cases of infection shows a decrease, but there are no reliable data to substantiate this opinion.

One of the main advantages to be gained by the use of "Agrisol" is that no extra labour is required for applying it, as this work is undertaken by the tapping cooly. There are several kinds of "Agrisol," the cheapest being the uncoloured "Agrisol," but it has been found preferable to use one of the coloured varieties, as it is then possible to tell at a glance whether the tree has been treated, whereas if the uncoloured kind is used, there is no means of detecting unpainted trees.

During the Agrisol experiment, the trees were painted every 12 days, but since then the period between each painting has been reduced to 10 days.

In addition to the painting undertaken by the tappers, four trained coolies are employed in going round the whole of the area in tapping, and it is their duty to take out of tapping any trees on which the fungus appears to have obtained a hold, and, on such trees, the surface recently excised is painted with a mixture of 50 per cent. tar and 50 per cent. Brunolinum. Such trees are marked, and examined at the end of a month, and if they appear to have recovered, they are again brought into the tapping round.

Taken over a period of five months (July/November), the monthly average cost of the "Agrisol" treatment works out as follows:

Monthly average cost of labour	...	$ 44.16
,, ,, ,, Agrisol	...	105.50
Total	...	$149.66

The cost of this treatment works out at 10¼ cents per acre per month, Agrisol does not appear to have an injurious effect on the tree scrap or bark. The measure of success which has attended our efforts to deal effectively with this disease is, I am sure, largely due to the keen interest taken by the assistants, under whose control the treatment has been carried out, and also to the fact that Tamil labour, which is amenable to reason, is the only kind of labour employed on this estate."

A. S.

DISTRIBUTION OF PINK DISEASE IN FEDERATED MALAY STATES MUKIMS. 1920.

REPORTS on the distribution of pink disease for the year 1920 shew that a general improvement has been accomplished, but that the disease is still prevalent in Perak, and particularly in Ulu Selangor. The most marked improvement occurs in Perak, where seventeen among sixty-two mukims are reported to be entirely free from pink disease, while in twenty-three cases the present condition is described as "slight." The condition, however, is still bad in Selama, and in parts of Kuala Kangsar, where the disease had obtained a strong footing as far back as 1917. The only new outbreak in Perak occurred in Kroh, and was slight.

In the Negri Sembilan and in Pahang, the disease has been completely eradicated in two mukims, while in eighteen mukims where it had obtained a moderately strong footing, the condition has been considerably improved. Seventeen mukims are now free from the disease. No new outbreak has been reported, and in no mukim is the disease at present serious.

In Raub and Bentong, the present condition is moderate generally, but bad in Tras and in Sabai; no case has been reported from either Batu Talam or Ulu Dong, where, however, the number of rubber holdings is small.

In Selangor, the disease appears to be on the increase around Rawang, Semonyih, and in the area between Kuala Kubu and Tanjong Malim. On the other hand, a general improvement has taken place at Ampang Pechah, Rasa, and Serendah. One new outbreak has been recorded, viz., on an estate at Batu Caves, but is slight. The tendency from 1916 to 1918 was undoubtedly one of improvement, and this has, on the whole, been maintained.

The results of Court cases for pink disease are as follows:

—	No. of cases.	Con.	Acq.	Max.	Min.	Total fines.	Costs.
				$	$	$	$
Perak North	85	76	9	50	.50	812.00	7 50
Perak South	37	35	2	50	.50	435.00	16.00
Selangor	14	12	2	36	3.00	233.50	.50
Negri Sembilan ...	11	11	....	100	5.00	325.00	3.50
Pahang	9	8	1	150	5.00	300.00	3.50
Johore	5	4	1	50	5.00	130.00	2.00
Totals ...	161	146	15	150	.50	2,235.50	33.00

F. W. S.

THE "FIJI" DISEASE OF SUGAR CANE.

A statement regarding a serious disease of sugar-cane was circulated recently by the Chief of the Plant Disease Survey of the United States Government. A copy of the circular has been transmitted to the Imperial Commissioner, West Indies, by the Director of the Imperial Bureau of Mycology.

The disease owes its provisional name to the fact that it was first discovered in the Fiji Islands, where it has been present since 1905 at least. It was seen some years later on native cane in New Guinea, and in 1920 was found to be present in New South Wales and in the Philippines (the Island of Mindoro). Its original home is probably New Guinea, whence it has doubtless been spread in native varieties, one of which, the Badila cane, has been cultivated in Australia for a number of years, and has found its way into cane-growing countries elsewhere, including the West Indies.

No thorough investigation of the disease has yet been published. Much of the information available is due to H. L. Lyon, Plant Pathologist at the Experiment Station of the Hawaii Sugar Planters' Association. He studied the disease while visiting the Fiji Islands, and recorded the results of his investigations in the Hawaii Planters' Record in 1910 and 1911. Lyon describes the disease in these words:

"The most conspicuous symptom of the Fiji disease to be noted in the field is the shortening and the crumpling of the last leaves to unfold from the spindle. This peculiarity will attract the attention when one is still a considerable distance from the affected cane. The shoot may have attained considerable length, and be clothed with many healthy-looking leaves of the usual colour and length, but suddenly it loses the power to produce normal leaves, and throws out a few bent and twisted stumps, and then ceases to grow altogether. Some of the eyes may start, but the resulting "lalas" soon repeat the antics of the main stem. The stalk may remain alive for months, or it may soon die.

"When such a stick is examined, the characteristic galls are usually to be found on most of the healthy-looking leaves, which are not otherwise distorted, and on all of the deformed, aborted leaves. These latter leaves look as though they had been burned or scalded before expanding, the injury destroying the upper half or two-thirds of the leaf-blades, leaving short, crumpled stumps.

"As indicated above, this abortion and distortion of the young leaves mark the culmination of the disease in a shoot, and the last efforts of the growing point to throw out leaves. A shoot will throw out leaf after leaf bearing galls, but otherwise, may grow for months, as though perfectly healthy; then suddenly comes this final spasm in its growth, and it is finished. The appearance of galls on the leaves is the first outward symptom by which the

disease may be detected, but a cane may be hopelessly infected with it for months, before any galls appear. The disease is therefore cumulative in the cane; the galls mark a well-advanced stage of the disease, and the distortion of the apical bud its final culmination.

"The one symptom which always marks canes, affected with this disease, is the occurrence of elongated swellings or galls on the under surface of the leaves. These galls extend along the veins or vascular bundles, and are formed by abnormal growth of the tissues composing these bundles. The vascular bundles in the stem are also found to be affected in a similar manner, their enlargement greatly reducing the bulk of the sugar-bearing parenchyma.

"No variety of cane has yet been found which is immune to this disease. Some varieties will grow eighteen months or more after infection, before any galls appear. On other varieties, however, the galls appear soon after infection, and the final spasm quickly follows. Thus it is that some of the more susceptible varieties are unable to make any growth at all on soil containing the germs of this disease.

"Fiji disease is far more prevalent in cane growing on rich soil than it is in the same variety growing on poor soil, and this indicates the only method of combating it that has yet been devised. All seed is taken from fields having poor soil. When cutting this seed, men are sent ahead to cut out or tie up every stool showing the slightest symptom of disease, and these are left untouched by the seed-cutter. In this way it is possible to get seed comparatively free from infection. The majority of the resulting stools are able to grow two years or more, before disease overtakes and destroys them.

"In view of the above facts, it is needless to say that no cane whatsoever, be it ever so healthy in appearance, can be brought from Fiji to Hawaii and planted, without incurring the gravest dangers of introducing this dreaded disease into our fields."

In a preliminary report on the cause of the disease, published in Hawaii Planters' Record in 1910, Lyon records the finding of a plasmodium in the cells of the leaf galls, suggestive of a slime-mould (*myxomycete*), the swarm spores of which, he believed, might gain entrance to the cane tissue by penetrating the roots, and then following up the vascular bundles to the leaves. He also thought that the organism could live in the soil for a considerable time like *Plasmodiophora brassicae*, Wor., the slime-mould causing the well-known club-root of cabbage and other crucifers. He furnished no definite evidence proving the causal relation of his organism to Fiji disease.

In this connection it may be of interest to refer again to the recent discovery by J. Matz of a similar organism in the vascular system of cane in Porto Rico, showing symptoms of root disease and dry top-rot. (*See* Agricultural News (Barbaros), Vol. XX, No. 497, page 158.)

It would appear that Fiji disease can be spread readily by planting cuttings from affected stools, and also that the infection can be retained in, and transmitted through, the soil. By 1910 the disease had spread through the whole cane area in one of the Fiji Islands.

With regard to the losses involved, Lyon stated that it is one of the most serious diseases yet recorded on cane, while O. A. Reinking, Plant Pathologist, at the Philippine College of Agriculture, who saw the disease in Mindoro, states that it is one of the most destructive plant diseases that he has seen in the Philippines.

The symptoms of disease in these islands are similar to those which occur in Fiji. Badly affected plants are small, stunted, and bunchy in the top. An excessive number of shoots is produced and the leaves are darker green and more slender than normal leaves. Galls on the leaves are almost always present; they show as elongated lighter green blisters on the midribs or veins from 1 inch over 2½ inches in length. When young they are transparent, but thick and opaque when old. They are present on the young leaves before they unfold, and are most abundant near the base of the blade, but also occur on the sheaths; they have not been observed on the stalks. Plasmodial bodies have been detected in the galls. The root system of the affected plant-cane is small, bunchy and rotted, and these abnormalities are still more marked in ratoons. The young shoots arising from a diseased stool usually have distorted and wrinkled leaves. Discolouration of the younger leaves and a wet top-rot sometimes occur, but are probably secondary. Fields may show patches of dead cane, and in severely affected ratoons the loss may be total or may run from 50 to 75 per cent. of the crop. The Java and Hawaii seedlings P.O.J., 247, and H. 109 are severely affected, and the disease has been spread in Mindoro by them. The Philippine canes are more resistant, and their cultivation in diseased areas has been advised to the exclusion of imported varieties. It is evident that the importation of canes from Australia, Fiji, New Guinea, and the Philippines into the West Indies must be rigidly prohibited, and canes introduced from any of these countries within recent years should be carefully inspected.

Anticipating the possible introduction of the disease into Hawaii, the Sugar Planters' Experiment Station sent cuttings of many varieties to Fiji in order to test their relative resistance against the disease. Now that the disease has been detected in the Philippines, and found to be destructive there (it has not been reported from the chief cane-growing island, Negros), it will doubtless be closely studied, and the results of the investigation made known to the world.

In conclusion it may be stated that the information in this article has been derived both from the circular already mentioned, and from two articles by O. A. Reinking, which appeared in the Manila Sugar Central and Planters' News of November, 1920, and February of the present year. The substance of these articles has been published in "Facts About Sugar" of 2nd April, 1921.

According to an article contributed from the Laboratory of Plant Pathology, Bureau of Agriculture, Manila, to the "Philippine Farmer" for January of the present year, it may be stated on good authority that this disease is now under practically complete control in Fiji. This condition has been brought about by unabated planting material selection. Experienced labourers go along the rows and cut only from stools which show no signs of the disease. Partially affected stools are rejected. If such selection is neglected for a few seasons, fields of plant cane show a rapid increase in the proportion of infected stools. The variety or varieties mostly grown in Fiji are not mentioned, but the statement is made that Striped Singapore, Badila and Rose Bamboo are resistant.

(Reprinted from Agricultural News, Barbados.)

A. S.

REPORT OF THE WORK OF THE INSPECTION STAFF, OCTOBER, NOVEMBER AND DECEMBER, 1921.

By F. W. South.

Staff.

The staff of the Inspection Division was during the quarter brought up to full strength by the filling of the two remaining vacancies. Additions to and redistribution of the staff of Malay Agricultural Inspectors were also made, resulting in the areas in charge of certain of these officers being reduced and permitting greater concentration on the smaller areas.

Inspection Visits.

Sixty-nine visits were paid by various members of the Inspection Staff during the quarter.

Instructions have been given that Inspecting Officers shall commence regular visits in rotation to all estates in the area under their charge.

Diseases of Rubber.

Pink Disease.—This was newly reported from two estates in Negri Sembilan and from six estates in Johore. Work on its control was actively maintained everywhere. The work in Ulu Selangor district done by the Special Field Officers and the Junior Agricultural Assistant has had an excellent effect. The prevalence of the disease has been greatly reduced and smallholders are beginning to realize that if proper treatment is not carried out at intervals they are liable to get into trouble. In several cases of failure to comply with notices, the work has been done and the cost been recovered from the owner. In Malacca there has been no reappearance of the disease during the quarter. In Johore it was discovered neglected and in an advanced stage on one European and one Chinese managed estate.

Mouldy Rot.—This disease was newly reported from four estates in Negri Sembilan and one estate in Johore. On the Negri Sembilan estates it was promptly treated and did very little damage. The estate in Johore was Chinese owned and the treatment in progress was not very satisfactory.

In Seremban district the weather was fairly dry and the disease was checked, but the bad condition of the holdings in Rantau neighbourhood still causes difficulty in controlling it. Work was done on a few holdings by the department when owners failed to obey instructions.

In Kuala Pilah district the rainfall was heavier during the quarter and the disease tended to become more prevalent. Owing to the efforts of the Special Field Officer, however, the disease now receives far more regular treatment.

In Jelebu district the disease was kept effectively under control. Only four holdings were infected at the close of the year and all were receiving proper attention. The Special Field Officer had persuaded owners to pay attention to cleaning and thinning out their holdings with useful results.

In Rembau district high winds kept the atmospheric conditions in the holdings fairly dry and the disease was checked. There was a distinct improvement and better attention was given to the instructions issued.

In the Coast district there was an outbreak in Chuah mukim in October. This received attention and the disease did not spread. It is, however, still prevalent in the part of the district between Rantau and Pengkalen Kempas.

Generally in Negri Sembilan the work of the Special Field Officers has resulted in far more attention being given to the treatment of the disease, but the work is still handicapped by the difficulty of inducing owners of small holdings to stop tapping with rubber at its present low price.

In Temerloh district of Pahang the disease was still present. It continues to receive attention, but a Special Field Officer could not be spared during the quarter. Some owners have ceased tapping in the infected area and this will help to check the disease.

In Malacca the disease continued to be present, though to a less extent, on the estate referred to in my previous report. Treatment under the supervision of the Assistant Agricultural Inspector was continued steadily. No other localities were found to be infected.

In Johore with the advent of the rainy season the disease again appeared at Tampoi near Johore Bahru, but was checked at once and no cases were found during the second six weeks of the quarter. A number of cases was found in Batu Pahat district, but this outbreak is also in hand. In Segamat district a number of the holdings at Labis became once more badly infected; this outbreak also was checked. There has been a very considerable improvement in the condition of the holdings near Muar. Most of the undergrowth has been cleared in accordance with instructions and the majority of the owners have painted their infected trees. The condition of the holdings at Panchor was unsatisfactory and will receive attention.

Black Stripe.—There were no new reports of this disease on estates during the quarter. An outbreak in the small holdings near Kajang is receiving attention; the main difficulty in controlling it has been that the owners will not change the position of the tapping cut on the tree. The disease reappeared on Jelebu Estate in October accompanied by leaf fall and what appeared to be pod-rot. It was at first somewhat prevalent, but later was well under control though still present. An outbreak in the Perak mukim of Temerloh district was receiving attention.

No other diseases of rubber call for special mention during this quarter.

Miscellaneous.—During the dry weather crickets were reported to be eating and damaging the renewing bark of rubber trees on one estate in Malacca and similar damage was reported from other estates. When the weather became wetter the damage ceased.

There was an interesting record of damage to rubber trees caused by arsenic. A mixture of lime, sulphur and arsenic had been applied to a number of trees on an estate in Perak to prevent deer from eating the bark. On some of the trees the arsenic penetrated the bark and ringed the trees. As a result about 50 trees were killed or severely damaged.

Lalang and Blukar.

The policy with regard to the clearing of holdings from lalang and undergrowth has remained unchanged. A slight improvement in the price of rubber during the quarter caused many owners to recommence tapping and partly to clean up their land for this purpose; at present, however, the price of rubber is too low to justify enforcing any expensive work on rubber holdings except under special circumstances. In parts of Selangor and in Kuantan district coconut holdings are being cleared under orders from the inspectors.

Coconut Pests and Diseases.

Beetles.—Measures for the control of the black beetle and the red stripe weevil by destroying all suitable breeding grounds have been continued steadily in the Federated Malay States and the Colony during the quarter. Bagan Datoh, Kuala Selangor, Klang and the neighbourhood of Port Dickson have become rather badly infected and are receiving special attention. The work in Malacca has progressed well and had a marked effect. Active measures are being taken in Singapore Island with useful results, but the difficulty of ascertaining by whom land is owned in many cases hampers the work there.

At the request of the Assistant Agricultural Inspector, Selangor, a second incinerator has been erected at the Cattle Quarantine Station at Port Swettenham to destroy manure. The incinerator at Alor Gajah had been in use nine months at the end of the year and was still in good order.

Experiments as to traps for red stripe weevils were carried out in Malacca during November on behalf of the Entomologist.

Brachartona catoxantha.—Owing to the action of parasites, more especially the fungus parasite, this pest disappeared from the two small infected areas in Kinta and the large area at Telok Ayer Tawar in Province Wellesley mentioned in my previous report. There was an outbreak at Gaylang in Singapore Island which developed to a considerable extent but was eventually controlled mainly by the fungus parasite.

Spike Caterpillar.—A disease was reported from an estate near Batu Gajah that caused the newly formed nuts to fall and the stalks to turn back. It was subsequently found that this was caused by a caterpillar which attacks the newly opening flowers. This pest is under investigation.

Padi Pests.

Stem Borers.—The lectures on this subject to padi planters commenced last quarter in Krian were continued up to the end of November. Lectures were given at 11 mosques in all and more advanced and detailed lectures were given to Penghulus and Gurus at Titi Serong.

Nymphula depunctalis.—This pest did considerable damage to the nurseries at Matang. It did little damage to the plants in the bendangs but is still present in the locality in small numbers.

Parnara mathias.—In December various leaf eating caterpillars were reported to be damaging padi at Matang. Investigations showed that the chief pest was *Parnara mathias* although other species, including *Melanitis ismene*, were present. It was found that the Parnara larvae were fairly commonly parasitised by a hymenopteron and no spraying or other control measures were carried out, although a supply of lead arsenate was obtained in case spraying proved necessary. The parasite was effective and at the end of the year the leaf eating caterpillars were doing insignificant damage, although a few living specimens of Parnara larvae were still present in the bendangs.

Locusts.—At the beginning of October the District Officer, Lower Perak, reported that locusts had destroyed over 100 acres of hill padi at Sungei Wangi, Sitiawan. The insects proved to be a local species more in the nature of a grasshopper than a locust. They were not present in definite swarms but were scattered over a large area; the damage done by them had not been exaggerated. Owing to their activity and swift flight the adults could not be caught by hand nets during the daytime. Control measures employed were the sweeping of nurseries with hand nets to catch the nymphs and the capture of the adults at night by hand in large quantities from the tree stumps which were their favourite resting places. This outbreak was investigated by the Government Entomologist and the Assistant Agricultural Inspector, Perak North.

Grasshoppers.—Various species of these insects are universally present on padi. One outbreak in which 50 per cent. of the crop was damaged was reported from Kuantan. Owing to the danger of using poison baits in this locality the insects were caught by hand. The Government Entomologist is investigating the life history of the commoner species of padi grasshoppers with a view to control measures and has been supplied with suitable egg masses from Krian.

Mole crickets, Gryllotalpa sp.—These insects did some damage at Kampong Gajah in Lower Perak during dry weather, but disappeared with the advent of rains. Poisoned baits were used for their control, but it was difficult to decide to what extent the insects were killed by them and to what extent they were drowned by the rains.

Leptocorisa varicornis, "Pianggang".—This pest again made its appearance on padi near Raub in Pahang at the end of the quarter. Experiments to control it by the use of lamp traps at night and poisoned baits by day were commenced. It was also reported from a few localities in Malacca, but did no serious damage.

Podops coarctata, "Bena Kura" or "Kutu Bruang."—This pest did some damage at Ulu and Kampong Gajah in Lower Perak. It was also reported from Kuantan district and from various localities in Malacca, but in both it did but little damage. It usually developes into a pest only when the padi land is dry at the wrong time and in each case reported ceased to be of any importance when the weather became wetter. As has been pointed out before, the attacks of sucking insects such as Podops and the Jassid and Fulgorid bugs on padi are mainly dependent on unfavourable conditions of growth caused by lack of water, or stagnant water, and are best controlled by adequate measures for regulating the water supply.

Rats.—These animals damage padi throughout the country; they are specially mentioned as being destructive in Perak South, Kuantan and Malacca. Baits of padi poisoned with barium carbonate gave satisfactory results in Malacca, but unfortunately the supply of the poison obtainable locally became exhausted. A large supply has been ordered by the department to be given out at cost price to padi planters where required. Trapping when carefully and systematically carried out is also effective. Organized measures continued throughout the padi season are the only practical means of control.

A fungus known locally as Sakit Benah, but as yet not investigated is reported to do a little damage in Kuantan district.

Water-Hyacinth.

In Perak North the regular gang, reduced to four coolies, did routine work in clearing Water-Hyacinth from rivers and State lands in Krian. It appears probable that a gang of four coolies will be sufficient to attend to routine work on this pest in Perak.

Orders were given to certain Chinese squatters who breed pigs near Telok Anson to remove Water-Hyacinth from ponds on their land. The use of this pest as a pig feed is common among Chinese and has to be watched and prevented.

Other Pests.

Limes.—Specimens of pupae obtained from large caterpillars boring into the fruits of "Borneo Limes" in Perak were forwarded to the Entomologist together with flies bred from larvae found in the limes which had decayed as a result of attacks by the above mentioned caterpillars.

Mimosa.—The Assistant Agricultural Inspector, Pahang West, reports further that the Mimosa spraying experiments were a total failure, as even with an extremely strong solution of sodium arsenite it is impossible to kill the roots of the mimosa. The experiments may be regarded as giving a definitely negative result.

Notes on General Agriculture.

A certain number of estates throughout the Peninsula have carried out the budding of rubber on a field scale and have planted out small clearings, or parts of larger clearings, with budded stock. The selection of suitable trees giving high yields from which to take the bud wood has been based more on judgment and general field observations than on accurate records of daily yields, since selection of high yielding trees by accurate records has not yet proceeded far in this country. The interest of managers in this subject has been general.

Abstract of Meteorological Readings in the various Districts of Malaya for the month of October, 1921.

District.	Mean Barometrical Pressure at 32° Fall.	Maximum in Sun.	Temperature.				Hygrometer.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Kota Bahru	...	145.77	80.7	88.54	73.83	14.70	75.9	.804	72.7	76.	...	17.67	3.68
Pahang, Kuala Lipis	...	...	79.08	87.77	74.45	13,32	75.41	...	...	...	...	22.01	4.29
Johore, Johore Bahru	...	...	...	87.58	73.38	...	...	...	...	...	...	14.35	2.92
Singapore, Kandang Kerbau ...	1015.1	...	79.6	84.1	77.1	7.0	77.1	...	...	...	Calm	15.00	6.02
Malacca, Durian Daun	1017.7	125.0	82.	87.	74.	13.0	77.1	.902	...	83.	N.E.	10.86	2.24
Negri Sembilan, Seremban ...	...	143.1	80.1	88.9	73.7	15.2	76.1	.821	73.2	76.1	N.W.	3.34	.47
,, Kuala Pilah ...	...	152.4	80.9	88.1	...	...	77.6	.875	75.2	83.4	...	9.14	1.65
,, Port Dickson	...	129.5	81.6	87.2	73.8	13.4	78.2	.869	74.9	81.6	...	5.59	1.49
Selangor, Kuala Lumpur ...	...	...	82.3	90.3	71.0	19.3	76.7	.812	72.9	73.	S.E.	7.59	2.55
,, Klang	...	...	80.6	83.2	73.9	9.3	76.3	...	...	...	...	5.88	1.82
,, Kuala Selangor ...	...	...	...	89.8	70.0	19.8	...	...	...	...	...	8.79	3.93
,, Rawang	...	...	...	89.7	...	...	...	...	...	...	...	23.4	2.92
Perak, Telok Anson	...	...	80.91	91.	62.	29.	77.05	.879	...	85.	...	8.85	1.92
,, Ipoh	...	...	80.40	92.	71.	21.	78.28	.938	73.35	91.	...	15.23	1.53
,, Taiping	...	107.	81.00	92.	71.	21.	76.89	.868	...	82.	...	38.07	4.56
,, The Cottage	...	...	...	...	...	...	...	...	...	...	...	71.29	4.99
,, Parit Buntar	...	...	81.56	91.	71.	20.	77.51	.890	...	83.	...	11.1	2.55
Penang, George Town	1010.9	151.	80.2	91.	70.	21.	77.9	.924	71.6	89.4	N.W.	15.43	2.71
Kedah, Alor Star	...	...	...	...	...	...	...	...	...	...	...	10.45	2.30
Perlis, Kangar	...	...	...	87.74	73.48	14.26	...	...	...	...	...	8.04	1.50

Abstract of Meteorological Readings in the various Districts of Malaya for the month of November, 1921.

District.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	Temperature.				Hygrometer.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Kota Bahru	...	143.71	80.8	87.70	73.96	13.73	76.	.810	72.9	77%	...	7.85	1.89
Pahang, Kuala Lipis	...	...	79.53	87.70	74.67	13.03	75.83	...	...	...	...	10.77	2.27
Johore, Johore Bahru	...	...	...	87.03	73.36	...	...	...	...	...	...	9.96	2.38
Singapore, Kandang Kerbau ...	1014.4	...	81.2	84.	76.2	...	77.4	...	...	...	Calm	10.12	2.11
Malacca, Durian Daun ...	1017.8	123.	80.	86.	74.	12.	77.	.905	...	84.	N.W.	8.93	1.32
Negri Sembilan, Seremban ...	...	130.8	80.4	88.7	73.9	14.8	75.	.768	71.2	73.	N.W.	5.72	.67
,, Kuala Pilah ...	...	152.2	80.7	87.4	...	...	77.5	.882	75.4	84.2	...	8.51	3.29
,, Port Dickson	...	139.03	81.4	87.2	73.4	13.8	74.	.865	74.8	80.4	...	8.59	1.18
Selangor, Kuala Lumpur ...	...	...	82.6	90.5	70.9	19.6	77.0	.818	73.1	73.	S.E.	5.05	.76
,, Klang	...	...	79.8	83.	74.4	8.7	76.5	...	...	...	...	11.27	2.03
,, Kuala Selangor ...	...	...	...	89.7	70.1	19.6	...	...	...	...	...	6.95	2.04
,, Rawang	...	...	...	88.3	...	...	...	...	...	...	...	4.48	.81
Perak, Telok Anson	...	...	81.63	90.	72.	18.	77.35	.882	...	83.	...	5.27	1.81
,, Ipoh	...	...	80.84	93.	71.	22.	76.41	.853	74.56	82.	...	7.99	1.18
,, Taiping	...	...	81.53	92.	71.	21.	78.19	.920	...	87.	...	15.96	2.00
,, The Cottage	...	...	...	...	...	...	...	...	...	...	...	15.63	2.08
,, Parit Buntar	...	...	81.69	92.	71.	21.	77.34	.881	...	83.	...	13.85	3.7
Penang, George Town	1009.6	159.	80.9	92.	70.	22.	77.9	.918	71	87.1	N.W.	13.19	4.72
Kedah, Alor Star	...	...	...	...	...	...	...	...	...	...	...	2.75	.62
Perlis, Kangar	...	...	...	87.46	73.10	14.36	...	...	...	...	...	7.07	.80

Abstract of Meteorological Readings in the various Districts of Malaya for the month of December. 1921.

District.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	Temperature.				Hygrometer.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Kota Bahru	...	140.00	79.4	86.25	72.25	14.00	74.8	.774	71.6	77%	...	13.84	3.40
Pahang, Kuala Lipis	...	...	79.56	86.06	74.03	12.03	74.97	...	...	...	...	7.41	1.85
Johore, Johore Bahru	...	...	...	87.03	73.36	...	...	...	...	...	...	9.96	2.38
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Malacca, Durian Daun	1017.3	126.	81.	88.	73.	15.	77.	.897	...	82.	N.	3.66	1.57
Negri Sembilan, Seremban ...	...	147.6	80.4	90.1	72.8	17.3	74.7	.768	71.1	73.11	N.	4.59	1.14
,, Kuala Pilah ...	...	152.1	80.8	87.8	74.3	13.5	77.3	.870	75.1	83.1	...	2.65	1.51
,, Port Dickson	...	140.4	82.04	84.8	73.7	11.1	77.5	.853	74.5	81.7	...	5.11	1.48
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,, Klang	...	...	80.0	83.8	74.1	9.7	76.4	...	...	...	...	4.26	1.36
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